SCIENTIFIC AMERICAN SUPPLEMENT No. 265

Scientific American Supplement, Vol. XI., No. 265.
Scientific American, established 1845.

NEW YORK, JANUARY 29, 1881.

Scientific American Supplement, $5 a year.
Scientific American and Supplement, $7 a year.

## AMERICA'S COAL SUPPLY.

MR. P. W. SHEAFER, of Pottsville, writes as follows respecting the supply of coal of the United States, and the methods of mining it: The coal resources of Great Britain are all developed now, and in process of depletion; while in this country, when our four hundred and seventy square miles of anthracite are exhausted, we have more than four hundred times that area, or 200,000 square miles of bituminous, from which to supply ourselves and the rest of mankind with fuel. The coal product of the world is about 300,000,000 tons annually. The North American continent could supply it all for two hundred years. With an annual production of 50,000,000, it would require twelve centuries to exhaust the supply. But with a uniform product of 100,000,000 tons per annum, the end of the bituminous supply would be reached in eight hundred years. What the annual consumption will be when this continent supports a teeming population of 400,000,000 souls, as will be the case some day, must be left to conjecture. But with half that population, as energetic, restless, and inventive as our people in this stimulating climate have always been, under the hopes of success such a country as this constantly holds out to tempt ambition and reward enterprise, it is a very moderate estimate, guided by the actual output already reached in Great Britain, to suppose that there will be ample use for one hundred million tons a year of bituminous coal for home consumption alone.

We have about three hundred and forty collieries, and produce 20,000,000 tons per annum, or about 60,000 tons each. Great Britain has nearly four thousand collieries, and mines 132,000,000 tons, or 33,000 tons per colliery. The greater the yield per colliery the less the expense in mining. If we decrease the number of mines and increase their capacity not only to raise the coal, but to exhaust a constant current of foul air and dangerous gases, clouds of powder, smoke, and millions of gallons of water, we will reduce the cost of mining. Most of the anthracite mining in the United States is now done at a less depth than five hundred feet vertical; but as the coal nearer the surface becomes exhausted the mines must go deeper and become more expensive.—*Proceedings American Association.*

## IMPROVED PORTABLE COMPOUND ENGINE.

THE compound portable exhibited at the late Smithfield Show by Messrs. Marshall, Sons & Co., of Gainsboro, Eng., is one rated by them as a 14-horse, and is a high-class engine in every respect. It is of the intermediate receiver type, with cranks at right angles. The cylinders are 6⅝ inches and 10½ inches in diameter respectively, while the stroke is 14 inches. The cylinders are both thoroughly steam-jacketed, and the high-pressure cylinder is fitted with a cut-off slide automatically controlled by the governor. For starting under a full load a small auxiliary stop valve is provided, by means of which steam can be admitted direct to the low-pressure cylinder, this valve being, of course, closed after a start has been made. The boiler is made for a working pressure of 120 lb. per square inch, and is of ample size, while the exhaust nozzle is kept low in the smokebox, as in locomotive practice. As will be seen from our engravings, the engine is provided with the arrangement of plummer blocks sliding on the crankshaft brackets, which Messrs. Marshall have now long adopted for their larger en-

FIG. 1.

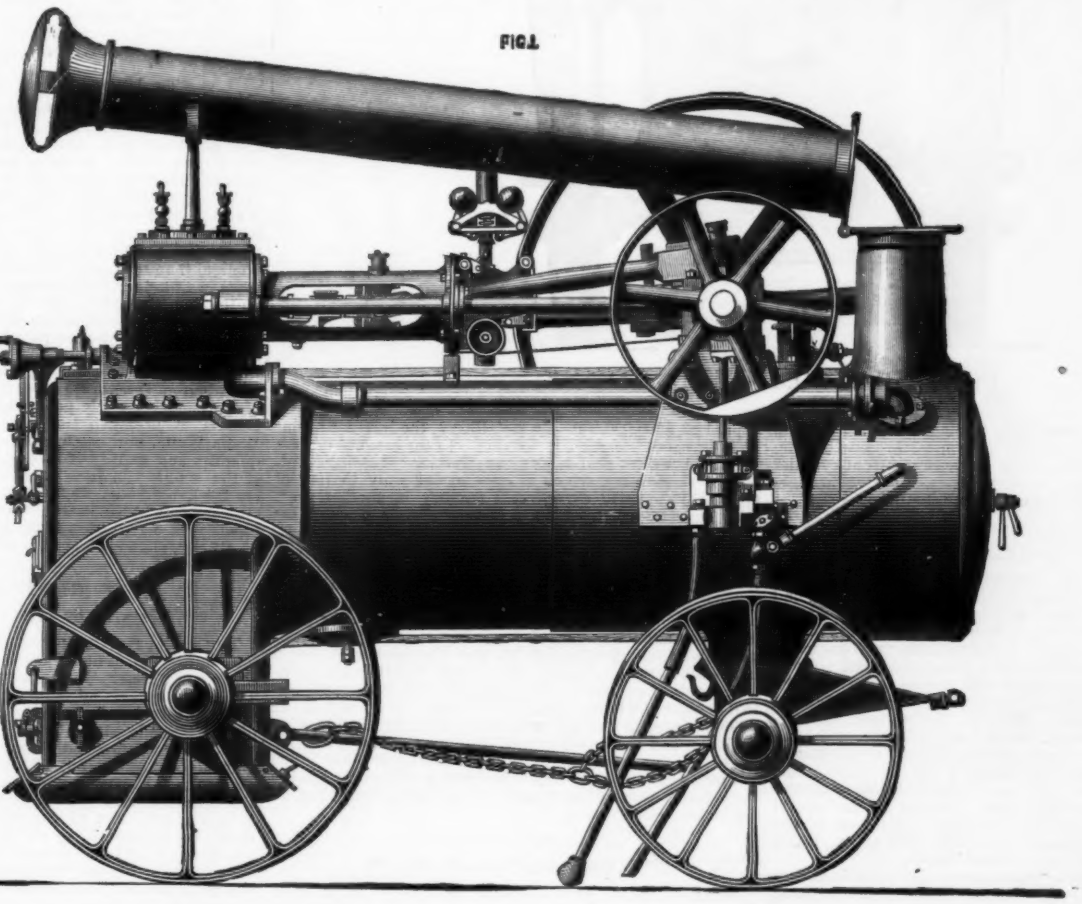
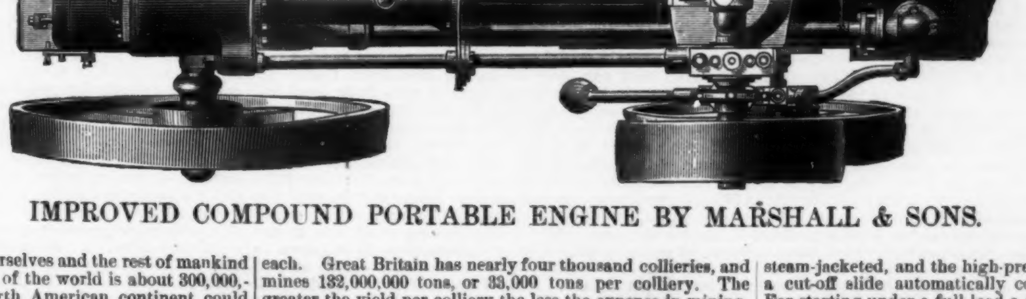
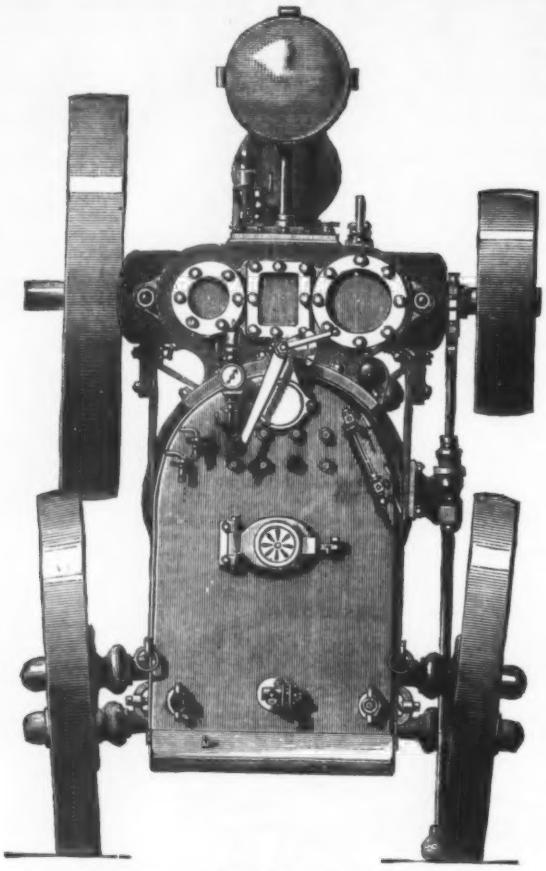


FIG. 2.



IMPROVED COMPOUND PORTABLE ENGINE BY MARSHALL & SONS.



PORTABLE COMPOUND ENGINE.

gines, the plummer blocks being connected to the cylinders by stiff tie-rods, which serve also to support the motion plate. The crosshead guides are cast in one with the front cylinder cover and are bored. The bearing surfaces are large throughout, and the engine is a thoroughly substantial job.

## PROGRESS OF ENGINEERING IN AMERICA.

UNTIL the close of the last century, natural power had ever been employed in its most primitive forms. Wind and water were the only motive powers called in to aid man in his labors; and the appliances to utilize them were of the simplest possible character. It is true some great engineering works were undertaken and completed; but only at large expenditure of mere labor and muscle. But with the introduction of steam, in 1778, a new wide field was opened up for the exercise of the genius of the engineer and mechanic. The invention of Watt was a triumph which set men to thinking, and its successful application contributed more to the prosperity and welfare of nations, and the advancement of science and mechanism, in the next succeeding century, than had been achieved by the united efforts of all previous time. Perhaps in no part of the world has it given birth to greater activity, or accomplished greater triumphs, than in the United States.

At a late meeting of civil engineers in St. Louis, a very interesting paper was read by Mr. O. Chanute, summarizing the progress and wonderful growth which engineering has made in this country, and alluding to the high position which the United States has attained among nations. From this paper we briefly summarize as follows: In the matter of supplying towns with water, the application of steam as a power, and the improvements made in pumping machines, engineers have made a gain of 50 per cent. over what was accomplished twenty years ago. There are now 569 towns and cities in the United States and Canada supplied with water works, involving 13,000 miles of pipe, 10,000 of which is of cast iron. Important progress has also been made in canal engineering; and we now have 3,257 miles of canal.

Experiments are in progress in the way of steam propulsion, which it is confidently expected will effect a saving of fully 37 per cent. over present methods. In railways, Americans were among the first to appreciate Stephenson's inventions of 1828, and are foremost among nations in utilizing it. The United States leads the world in the extent of her lines, reaching 86,000 miles; all Europe has but 90,000, and the balance of the world only 25,000. Our railroad engineers and locomotive builders lead all others. Our roads reach farther and cost less than any others, and our engines pull heavier trains and run more miles in a year, or during their lifetime, than those of any other nation. The Pennsylvania railroad was pronounced one of the best, if not the best, managed railroad in the world. [The present writer would name the Baltimore and Ohio as the only road whose management can be pronounced either equal or superior to that of the Pennsylvania.] In regard to bridges, there are now in the United States 900 miles of these structures—one-third of them stone or iron, and two-thirds wood. [The East River Bridge, at New York, may be instanced as the boldest conception of bridge construction ever attempted.] The matter of river improvements is just now attracting much attention, and the fact is being realized that, until quite recently, but little has really been done in this direction. It has been demonstrated that the currents of the largest rivers may be controlled by simple brush dikes. The movable dam on the Ohio—a French idea—has already proved a success, and the best engineering talent in the country is now engaged in effecting certain needed modifications required to meet the peculiar nature and needs of our rivers. The recent improvements to navigation at Hell Gate and Flood Rock were referred to as great and novel feats of engineering. In telegraphic and gas engineering we have made wonderful strides. In the former, we lead the world; in the latter, since 1850, the number of companies has increased from fifty to nine hundred, with a capital of $200,000,000. In metallurgy, the increase of our blast furnaces is especially notable. In the amount of iron produced, we are next to England, Germany standing third. Our steel industry, which is now second only to that of Great Britain, will exceed that country in another year. Our increase has been 50 per cent. in two years. Our mining industry, especially in regard to the precious metals, is simply enormous. The petroleum industry was briefly alluded to. Our exports of that product are now the fifth on the list in point of value. In agricultural engineering, our progress has been truly wonderful, and before this all other branches become as dust in the valley. In the plow alone the annual saving of labor in producing our crops amounts to fully $36,000,000 less than the same work would have cost thirty years ago. It is in ship-building and maritime trade alone that we have lost ground during the last two decades. The decadence is attributed to the war of the rebellion, and to unequal competition with England in shipbuilding, and the superiority of iron over wood—an industry to which our engineers and capitalists have not given proper attention; but it was confidently predicted that in the early future we shall once more assume our proper place on the ocean.—*Californian.*

## THE NEW OVERLAND ROUTE.

IN regard to the new overland route by way of New Mexico, and its probable effect on the business of the old Pacific roads, Mr. French, the government Auditor, says: "The Atchison, Topeka and Santa Fe R. Co. advertise the opening of this new overland route to the Pacific as likely to occur on or about Jan. 1, 1881. The Rio Mimbres has been reached by the Southern Pacific graders, and the road will soon be open for operation to that point—1,198 miles from San Francisco. The Atchison, Topeka and Santa Fe track has been laid to a point 125 miles south of Albuquerque, on the Rio Grande. The gap on Nov. 1, 1880, was probably not more than 100 miles, which will be laid by the two companies and brought into operation by the time advertised. The opening of this new route is pregnant with important questions, all of which cannot now be discussed. If distance, cost of operation, and profits controlled rates in the strife for business, the old route would have nothing to fear from such legitimate competition." After showing that the old route has an advantage over the new of 432 miles in distance between Chicago and San Francisco, and of 306 and 234 miles respectively in the distance to San Francisco from St. Louis and Kansas City, he continues: "Distance in these cases necessarily adds to cost and reduces profits, but aside from that the operating expenses of the main line of the old route are much lower in proportion to earnings, and probably lower in actual cost per passenger and per ton per mile than they can ever be on the line from Pueblo to Goshen—nearly 1,500 miles of country with little local business, and a scarcity of both water and fuel—true, without obstruction from snow, but often obstructed in other ways."

He next shows by tabular statements that the average amount of through business over the Union and Central Pacific Railroads during the past eight years has been $10,393,864 per annum, and proceeds as follows: "In this lies the most important question for the Government to consider at the present time. Under the sinking fund law 25 per cent. of probably $6,000,000 of this business is required to be paid into the treasury by the companies, equal, say, to $1,500,000 per annum. Should one-half only of this business be diverted to the new route, it would so reduce the net earnings of both companies, more especially those of the Central Pacific subsidized line, which has not a very large local business, that the Government share would be reduced more than one-half the $1,500,000 referred to. The matter is one of such importance as to demand the most careful consideration on the part of the Government, as bound up in it is the question of security and ultimate payment or the loss of the entire debt of these companies, which at maturity will probably amount to more than $100,000,000, even after all the compensation for transportation service has been applied thereon."

Auditor French then briefly considers the proposed consolidation of the Central and Union Pacific systems of railroad, including the Southern Pacific. He says: "Without entering into any detailed discussion of this question of consolidation it may be stated that the charter act authorizes such a consolidation to be made if the companies themselves choose to do so; that the consolidation would seem to be much more necessary for the conservation of the property, and securing the Government debt of the Central Pacific subsidized line, than it does for that of the Union Pacific; and that its general effect upon both transcontinental and local business would be in the direction of lower rates by reason of reduced expenses. Yet, should the consolidation take place, there would still remain the question of diversion of business to the new route and its effect upon the interest of the government—as the consolidated company might divert business from the subsidized line just as much as though no consolidation was entered into—as a subject for the law-making power to deal with."

### THE NORTHERN PACIFIC.

The progress already made in the work of construction is exhibited by the following table:

| | Miles. |
|---|---|
| In operation | 855 |
| Constructed and ready for operation | 87 |
| Under construction | 247 |
| Partially located | 340 |
| Not finally located | 720 |
| Not located | 250 |
| Projected | 120 |
| Total | 2,619 |

The estimated area of the grant of public lands to this company is 42,000,000 acres. The sales to date have averaged $3.50 per acre, and yielded upward of $9,000,000. Mr. French adds: "So far as seen, the lands granted to this company are worth much above the average of those granted to the other Pacific railroad companies. In Minnesota, in Washington Territory, in Montana, the timber lands embraced in the grant will be undoubtedly of great value when the railroad is built; without the road their value is more nominal than real; and the same may be said of their coal lands in Dakota and Washington Territories. From Fargo, on the Red River of the North, to the Little Missouri, a distance of 350 miles, all in the Territory of Dakota, lie some 9,000,000 acres of the company's lands, all of which is probably as good an average quality of wheat lands as can be found anywhere. From Ainsworth to Spokone Falls, in Washington Territory, some 125 miles, probably two-thirds of the lands is equally good wheat land with that found in Dakota, being much the same as that in the vicinity of Walla Walla, now celebrated for the excellence of both the quantity and quality of its crops." The financial condition of the company in June 30 last is exhibited by tables reporting the liabilities as $9,350,349 less than the assets, which are valued at $107,050,695. The gross receipts during the fiscal year were $6,639,324, and the total expenditures $5,412,804, showing a surplus of $1,226,520.

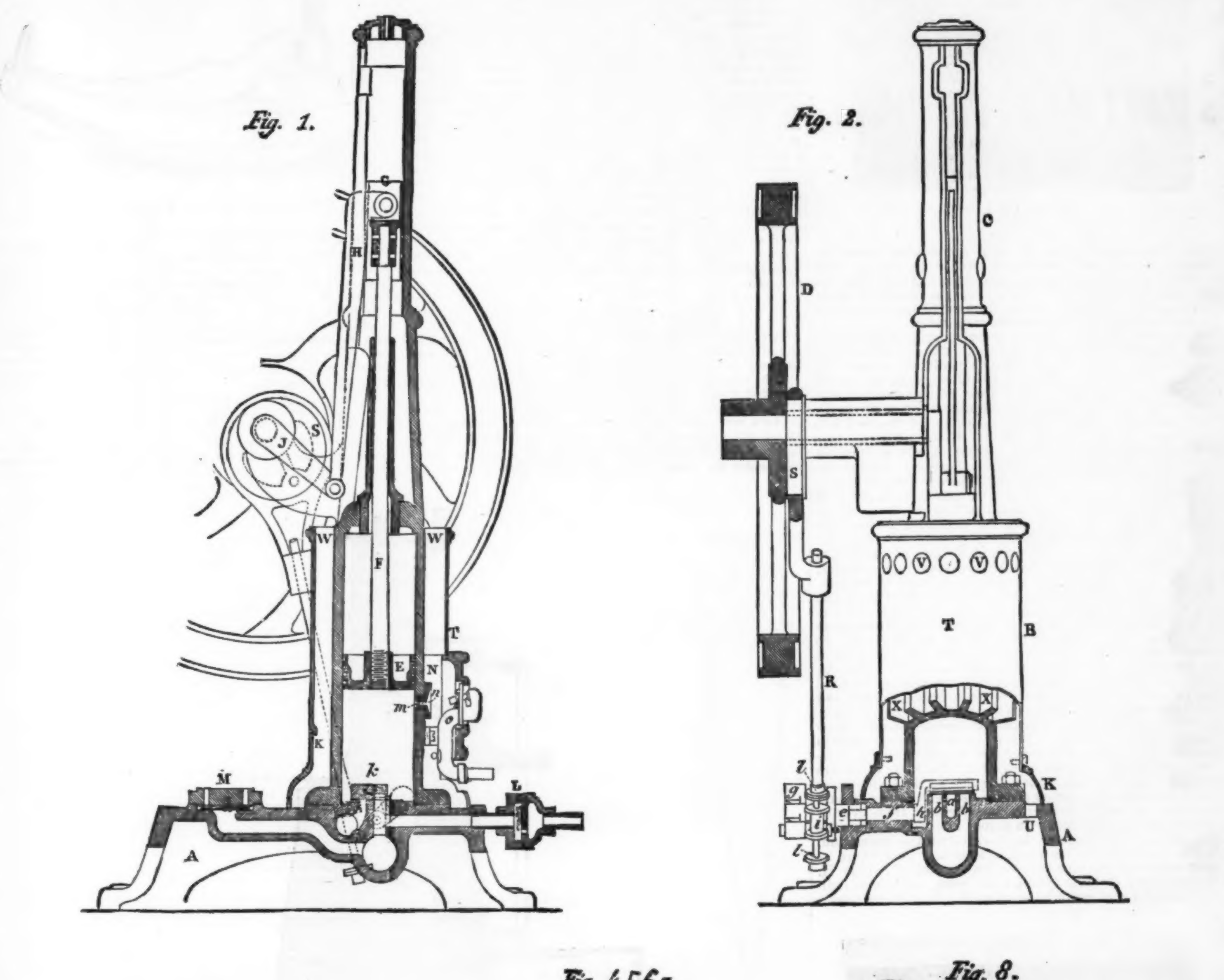
## GAS MOTORS.

### SYSTEM OF BUSS, SOMBART & CO.

THE engine represented on the next page, Figs. 1 to 8, is an improvement on a gas motor which was invented some time ago by Messrs. Buss, Sombart & Co., of Madgeburg. The improvements introduced relate to the distribution and to the burner used to light the gaseous mixture. The piston, E, is rendered air-tight in the cylinder by means of washers, so requires no oiling. The rod, F, the axle, G, and the connecting-rod, H, connect the piston with the crank, J. This is a single-action engine, and consequently the distribution has place only on one side of the cylinder. A tube of rubber or of any other fit material leads any gas which is combustible in air (such as coal gas, volatilized gasoline, etc.) into the engine through the valve, L, while the air enters through the valve, M. When the piston moves upward a mixture of atmospheric air and combustible gas is drawn into the cylinder until the piston has passed the aperture of the inflaming-valve, N, and the burner, O, then effects a quick combustion of the mixture of gas and air. The latter, on burning, acquires a very high pressure, and, by dilating, drives the piston to the extreme end of its travel. As the piston moves backward the products of combustion are expelled from the cylinder into the atmosphere through the tube, P. The distribution through the slide-valve is effected as follows: The surface on which rests the slide of the valve shown in Figs. 2 and 3 is composed of a rectangular projection from the bottom of the cylinder or on the upper face of the pedestal, A, of the engine. In this surface are located the apertures of the gas inlet pipe, *a*, the air inlet pipe (divided into two parts, *b b*¹), and the outlet pipe of the products of combustion. The slide-valve (Figs. 4 to 7) is composed of a thick rectangular piece of iron, in one side of which there is an elongated port, *d*, divided in a peculiar manner by several projections, *s*. During the ascending movement of the piston the slide assumes such a position that the port, *d*, comes over the inlet pipes, *a* and *b b*¹, while the outlet pipe, *c*, is completely closed by the solid part of the slide. During the descent of the piston the solid part of the slide comes over the inlet pipes, *a* and *b b*¹, and closes them, while the outlet pipe, *c*, remains wide open. In the air and gas inlet valves, L and M (Fig. 1), are inserted bands of rubber, which allow the gas and air to enter the cylinder but prevent its escape therefrom, since they close through the pressure of the gases as soon as these are inflamed. The shaft, *f*, passing through the packing-box, *e*, penetrates to the interior of the cylinder. Lever arms, *g* and *h*, are connected to this shaft on the inside and outside of the cylinder, the external one of which carries a wide-flanged collar, *i*, while the inner one engages in a vertical slot, *k*, cut in the slide. The eccentric rod, R, passes through the collar, *i*, and is provided with two leather cushioned disks, *l l*. As soon as the eccentric has passed through one of its dead centers it pushes the rod through the collar, *i*, until one of the disks, *l*, abuts against the latter and carries it with it. The slide valve moves then at certain intervals and remains at rest for a certain period between each of these displacements. The eccentric is placed in about such a way that the movements of the slide valve coincide with the passages of the crank through the dead centers, and that the slide remains stationary during the explosion and for a certain period afterward. The slide valve is kept in contact with its supporting surface, by the pressure of the gas as well as by its own weight, so that it always remains air-tight notwithstanding wear. The inflam-

ing-valve is on the Bishop system It is composed of a small steel plate, m, placed in the side of the cylinder, and which leaves the aperture, n, open until the moment of explosion, when it closes it. The gases are inflamed as follows: As soon as the piston, E, in its upward movement, has passed the aperture, the jet of the burner, o, directed against this valve, is drawn through the hole, n, into the interior of the cylinder, and the mixture of gas and air which fills the latter is inflamed. If, as in the Bishop and other motors, only a simple burner with one or several circular apertures be employed, the gases are inflamed in the interior of the cylinder only under certain conditions, *i. e.*, only when the gaseous mixture is very inflammable and possesses at the same time a very high temperature. In order to realize the latter condition, then, it becomes necessary to submit these motors to a preliminary heating every time it is desired to start them, and this is very annoying. But even when these two conditions are satisfied the lighting apparatus with the ordinary burner always presents this inconvenience, that the explosion does not take place exactly at the moment desired, but often much too late. This inconvenience is done away with by the use of the burner represented in Fig. 8. and which is composed of two pipes like those in a Giffard's injector. The gas issues from the inlet pipe through a conical nozzle which leads it into a tube, O, which draws in the air; and this tube then allows to flow with great rapidity a current of the two gases very intimately mixed. Another important improvement introduced into this engine is that of cooling without the use of water. Around the cylinder is placed a plate or cast-iron jacket, T, between which and the cylinder there are intervals sufficiently large to allow the air to circulate. Flanges, X, cast on the cylinder contribute still further to the same end and also prevent any axial or transverse displacement of the jacket. In the smaller engines the jacket is cast in one piece with the cylinder. The hot air rises between the cylinder and jacket through the apertures, V, or through the interspaces, W, between the flanges. During this time the hot air which escapes above is continuously drawing in cold air through the apertures, V, of the pedestal, A, and there is thus produced a brisk circulation of air, which is still further quickened by apertures let in the upper part of the cylinder.

These motors are limited exclusively to work requiring no more than one-horse power, and find their application more especially in those cases where it was necessary to make use of manual labor owing to the want of an appropriate mechanical motive power. The manufacturers are making three different models having respectively the power of 1½, 2, and 2½. and 5 to 6 men, or otherwise of ⅛, 1-6, 1-5 to ¼, and ½ to ¾ horse power. More than a hundred of these motors are already in use and working very satisfactorily. They require no water for cooling, and work noiselessly. They are shipped already mounted and ready to be set in operation when received. By a simple modification these motors may be run by the gas from gasoline, and thus they will prove of value to the inhabitants of small villages and to the owners of isolated habitations.




GAS MOTOR.—SYSTEM OF BUSS, SOMBART & CO.

## BLOWERS, OR OUTBURSTS OF GAS.

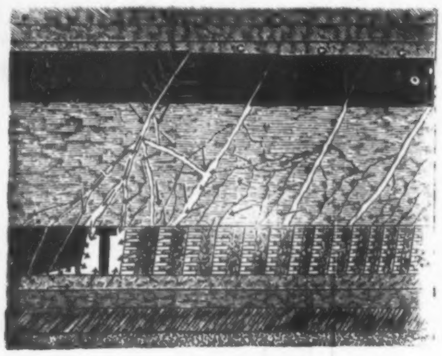
By W. PURDY.

WHERE the zone open to gas circulation is filled with gas there exists a reservoir of the most violent energy, which a hundred apparently trivial accidents may call into sudden and terrible action. It is now purposed to deal with some of the causes ulterior to the working seam, which may fill the zone with explosive gas.

Plan I. on next page represents a seam lying over and within the physical influence of a seam working a short distance below. It is known to most experienced miners that overlying measures are broken to a considerable distance above the current seam, and that heavy weights, or "top weights," are attended with much danger—not only on account of their violent and dangerous action, but on account of the copious discharges of firedamp that frequently accompanies them. Their violence is evidenced by the breaking of all the props within range of the influence, and by the immense pressure visibly exercised upon the goaf. The consequences of this violent subsidence is so well known to miners and colliery officials that all lights are immediately extinguished, and the men withdrawn until the gas generation has ceased, or at least subsided. The breaking and distortion of strata, caused by the wave of subsidence following the working face, is often seen when it is necessary to drive upward through the measures. At times the cracks or breaks in the measures are fully an inch in width. When an overlying seam is

worked, as shown in Plan I., the open breaks, just mentioned, cross each other, and give cause to another dangerous risk—that is, a treacherous condition of the roof. By an easy effort of the mind it will be conceived with what facility gas from a contiguous upper seam is conducted to the one worked, each fissure forming a channel of communication. At *gg*, Plan I., it will be noted that the upper

Fig. 2.

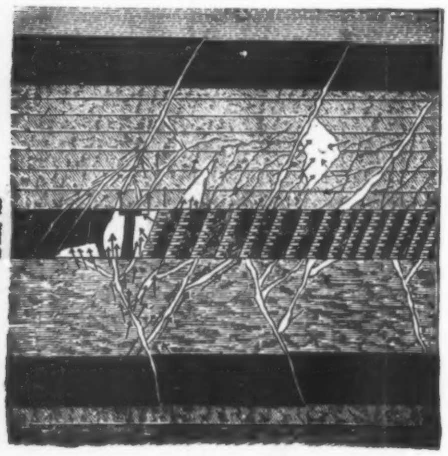


PLAN I.

seam forms a series of small steps—a condition caused by regular or irregular subsidence. The risks arising from working a seam near to an underlying and overlying one are, therefore, threefold. There is the gas generated by the seam at work, that given off by the seam above, augmented by the increment arising from the seam below.

In Plan II. is shown a seam of coal working in proximity to an overlying and underlying seam. The arrows indicate the communication of gas from each contiguous seam to the working one. There is a material difference in the operation by which gas is liberated from an upper seam and a lower one. In the former case the gas is set at liberty by the subsidence and consequent dislocation of the roof into breaks and fractures; in the latter it frees itself by its own inherent energy. The operation by which gas is liberated from the upper seam will be easily understood; that of the lower seam will be less easily so. When a seam of coal is first cut into, gas (in the case of a gaseous seam) is given off with great vivacity. The quantity will of necessity be limited by the area bared and the expansive force of the gas, regulated by the friction of the pores of the coal. As the coal is worked from the rib and the area of excavation is expanded the roof gradually breaks off and subsides, layer by layer, until the top stratum or surface is reached. The wave of subsidence then follows the working faces, and the condition of ordinary risks obtains. But there is a contingent risk which at any moment may fill the galleries with gas. That is the expansion of gas from the floor. By the excavation of the coal the resistance which kept the gas pent up is removed. The floor, as the area of excavation extends, becomes weaker and weaker, until the underlying confined gas becomes superior in energy to the resisting medium, and bursts its bonds with a roar. This operation may be illustrated by the generation, confinement, and emission of superpressure steam in boilers. When the valves are not equal to the pressure of steam it blows off, and would, of course, overcome smaller resistances much sooner. But if the valves are weighted down to a resistance over that of the boiler plates the boiler, should the steam continue to be generated, would explode. So in like manner is gas liberated from over or underlying seams of coal. In porous intervening strata the gas liberated would follow the laws of natural generation, but in intervening strata which is hard and impervious its generation will be in the mode of an "outburst." Plan II. represents an outburst from a lower seam, the arrows indicating the issue of gas into the seam (Fig. 2). In an example

Fig. 2.



PLAN II.

which came under the writer's notice, a seam underlay the working seam at a distance of 14 yards. The faces had extended about 150 yards from the pillars or posts, and the working faces were 500 or 600 yards in length, and there had been no "weight" for some time. It should be noted that the absence of weight on the goaf by subsidence of roof would have reduced the prior natural resistance to underlying gas to a minimum, and that, therefore, in the event of gas of any power being existent below, the conditions were ripe for its forcible emission. Such was the case. The "blower" was first perceived about 50 or 60 yards from the working face, on the traveling road. The packings were violently disturbed, and the upheaval of floor, accompanied with much noise, gradually approached the faces. At the faces, timber was placed to support in the expectation of a "top weight." The disturbance continued for about an hour—during the last ten minutes increasing greatly in violence. Gas now began to issue from the dislocated floor in great quantities and continued for some months, gradually ceasing. It depends much upon the nature of the floor whether the "outburst" be accompanied by a report. Sometimes the upheavals of floor will be transversely with the traffic roads, sometimes longitudinal with it. The small hillocks of upheaved floor in the former case being 6 or 8 yards apart, and in the latter the dislocation being 30 or 40 yards in length, and placing the road metals almost edgeways. At other times the "outburst" will be alongside the working faces.

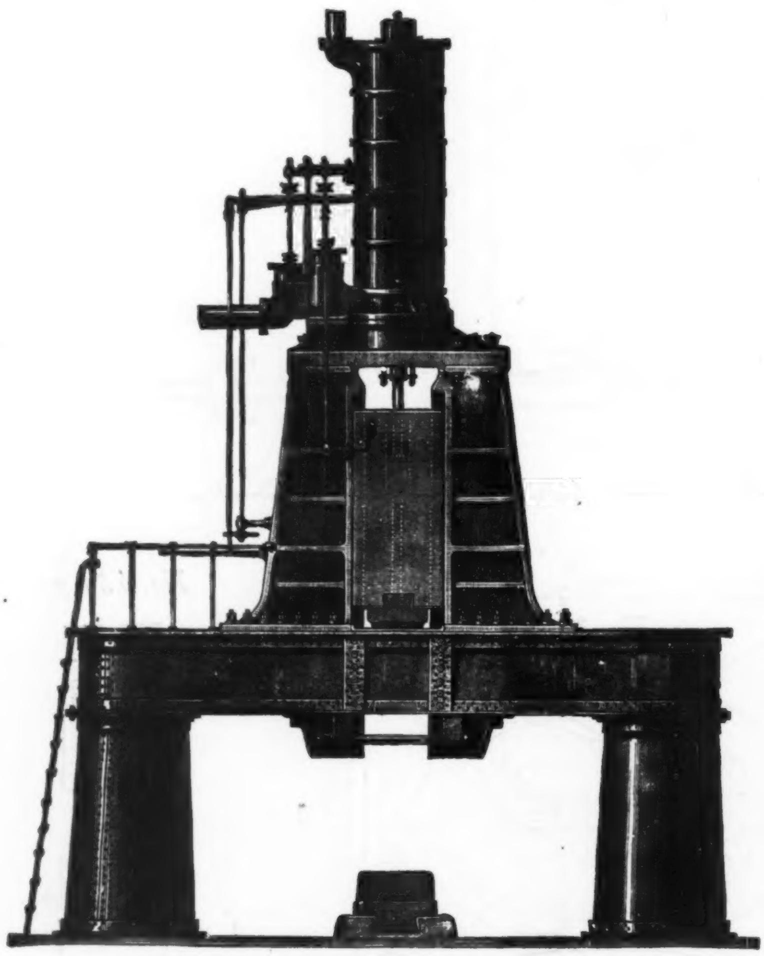
A "blower" of gas from below is far more dangerous than one from above. Light carbureted hydrogen, from its lighter specific gravity, rushes upward with great rapidity when released from below, while the gas released above may be partially if not wholly stored in the recesses of the goaf. During the passage of the gas from an underlying "blower" it must cross the ventilating current, and must, therefore, be carried to some distance before filtering into cavities over the current—if, indeed, it be not carried away altogether. With an overhead "blower" only such an amount of gas is ejected into the air current as the storage room in the goaf cannot accommodate. With an under "blower" the ventilation must contend with every particle emitted. To those conversant with mining the above will sufficiently explain the relative risks between under and over outbursts of gas. But what must be the remedy? Where the underlying seam is unworkable on account of its thinness or unmarketable qualities, the risk cannot very well be avoided, but where contiguous seams are workable, is there not an obvious avoidance of risk from under blowers by working the lower seam first? The lower seam should be kept at least a hundred yards in advance of the upper one. It is, I believe, a fact that blasting has been prohibited in seams working over another in consequence of the great liability to explosion from blowers, whereas bottom seams have been wrought by blasting with comparative immunity.—*Colliery Guardian.*

## IMPROVED STEAM HAMMER.

THE steam hammer shown in the annexed cut is worked at the Imperial Dock Yards at Wilhelmshafen, Germany. Our engraving is taken from the *Maschinen Constructeur.*

This hammer has a drop weight of fifteen tons, and is operated with a single acting steam cylinder.

This cylinder rests upon cast iron hammer guides, which in turn rest upon a heavy girder made of wrought iron plates, and supported at the ends by two heavy cast iron columns, which are of sufficient height to permit the men to pass under the girder. The columns are placed twenty-five feet from centers, thus permitting the largest and most cumbersome objects to be forged very readily.



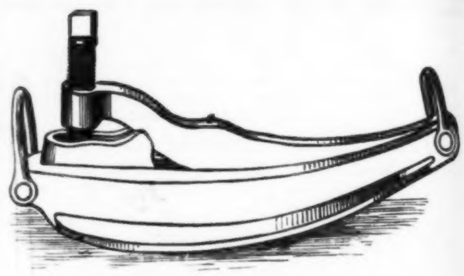
IMPROVED STEAM HAMMER.

The foundations of the anvil and of the columns are entirely independent, so as not to damage the latter by the blows upon the anvil.

## JACK-SCREWS FOR RAISING RAILS.

IN works of repair on railways, when it becomes necessary to raise rails and ties in order to prepare a level foundation for them, it is usually customary to employ an iron pinch bar twelve or fifteen feet long, maneuvered by from three to five men. In this operation the force of workmen is occupied not only in raising the rail, but also in keeping it lifted while one or two of the party are preparing a bed for the tie. This very primitive method has the inconvenience that it requires quite a number of men, and that it is attended with dangers and difficulties of execution in tunnels, on viaducts, and around stations. MM. Bergue & Co. have invented a substitute for the iron pinch-bar in the form of a jack-screw, the accompanying cut of which gives so exact an idea of it as to render a description unnecessary.

All the parts of this apparatus which are submitted to strain or friction are made of tempered iron or of steel. The weight of the tool is such that one man can carry it without difficulty, place it under the rail, and, without any aid whatever, raise rails and ties to the desired height. The operation does not take over two minutes, and the rail once brought into position the jack may remain in place without the least inconvenience to passing trains, and without the work being in the least hindered. The whole force is then left free to leveling up the ties.



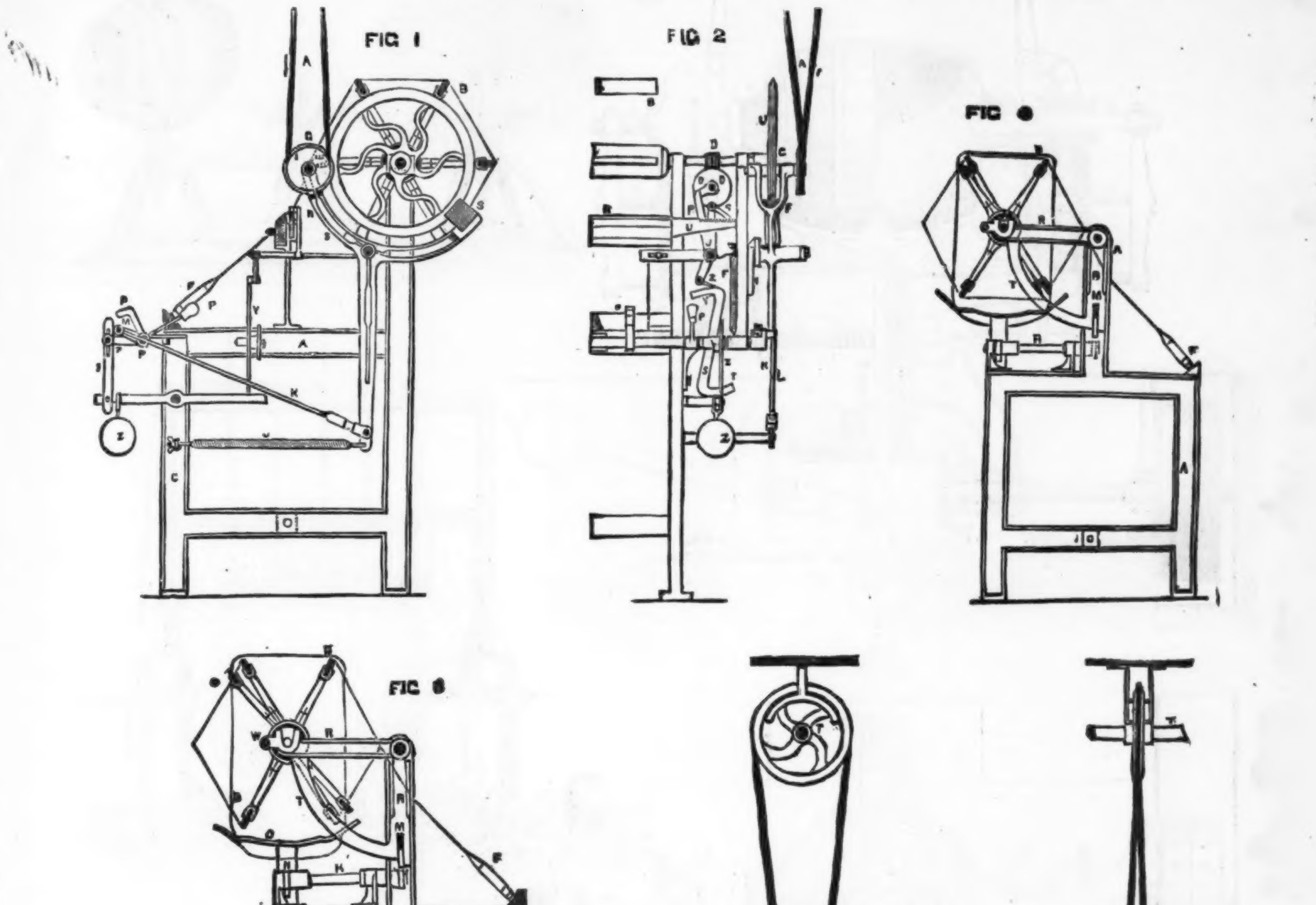
JACK-SCREW FOR RAISING RAILS.

The work is performed in the following way: The tool having been thrust under the rail so that the base of the latter rests on the part, *a*, the screw is turned by means of a key, and, without the necessity of removing the chair from the rail or from the tie, one man alone can raise the rail, fish-joints, and ties, as well as roadway crossings. It is well for each corps of laborers to have two of these tools, so that the work may be executed as advantageously as possible. This jack-screw has already been employed on a large number of English railways, and has been highly commended by their engineers.

## IMPROVEMENT IN WINDING MACHINES.

IN most spinning mills the winding machine preserves its primitive simplicity, and consists of two wooden or iron frames supporting the windle on which the skeins are formed. The latter is supplied at one end with a crank handle turned by the operative by hand, and at the other end is an endless screw which actuates a regulator. This acts on a spring or bell which tells the workman each time a certain quantity is finished, and he effects the lifts when the skeins are complete. An operative who wishes to make the machine conveniently produce about 26 lb. of No. 28 thread is forced to make the winder turn from 140 to 160 revolutions a minute. When a thread breaks or a bobbin empties, which frequently happens, the crank is left, the attendant runs, ties, and returns in haste to continue turning the windle or winder, and this labor continuing for 11 or 12 hours per day is very trying.

The object of the invention under notice, which is the work of Mr. J. Biedermann, is to somewhat simplify matters during this operation by the following means: 1st, to apply to the winding machine an apparatus intended to work it mechanically, to stop it, and to automatically divide the silvers, only requiring the operative's attention to the winding, tying the threads, and effecting the lifts, which conse-




## IMPROVEMENT IN WINDING MACHINES.

quently preserves the health and strength, while increasing the production of the machine by at least one-third; and, 2d, to adapt to the machine an apparatus destined to lift the winder or windle to allow of removing the manufactured skeins without removing the winder from the winding machine. By this means the lifts are more rapidly effected with very little trouble.

The accompanying drawings represent the improved mechanical winder. Front view, Figs. 1 and 5; in profile from the side at which the machine is driven, Fig. 2; and in profile from the side at which the skeins are removed, Figs. 3 and 6; and Fig. 4 is a plan of the machine.

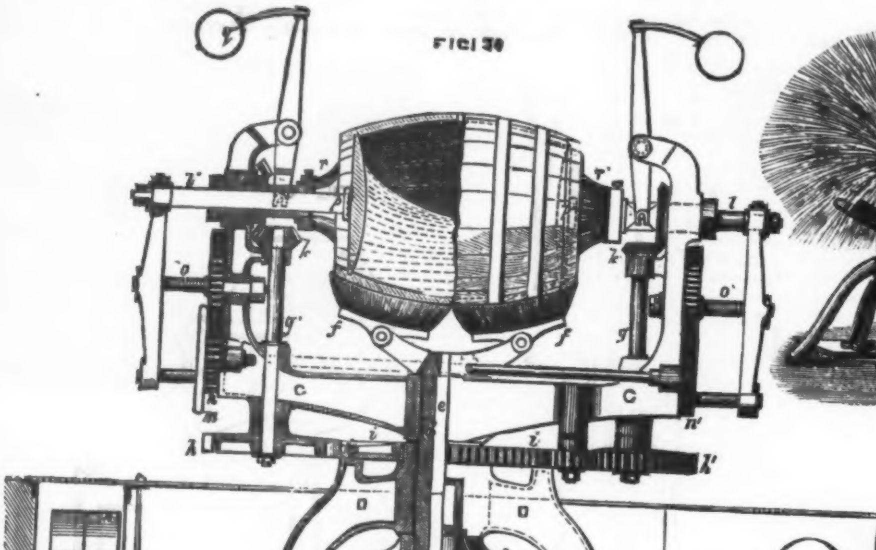
The frame is constructed of two cast iron sides, *a*, *a*, suitably strengthened by cross bars, and bearing above the ends of the axes of the winder, *b*, keyed between the two sides. Outside the frame, *a*, the shaft, $b^1$, of the windle receives the endless screw, *d*, which governs the regulator, *c*, and further on the fly wheel, *v*, with groove, with rectilinear and inclined faces. The roller, *g*, presents itself in this groove supported by the forked end of a lever, *f*, oscillating on the axis, *h*, fixed to the frame, and bearing at its posterior end a wooden block, *s*, constituting a brake on the fly, *v*.

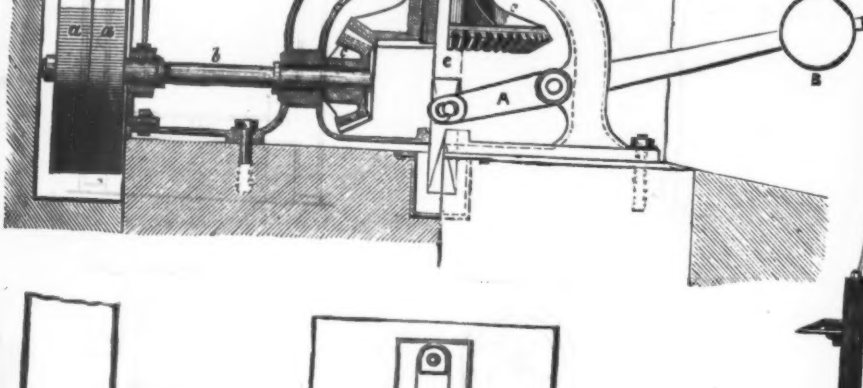
The lever, *f*, is solid with another lever, *l*, at the lower end of which the shaft, K, is articulated, which is itself jointed at the other end to the crank of the axis of the detent, *n*; this axis has a handle, *p*, with balance weight, $p^1$, to impart to the axis a partial rotary motion in one or other direction, according as it is desired to press the roller, *g*, on the fly, *v*, or separate it therefrom, and consequently applying the brake or block, *s*, to the rim of the fly, *v*. In a word, by manœuvering the handle, *p*, the winding frame is either set in motion or stopped. A spring, *j*, acts on the lever, *l*, to unlock the brake, *s*. An endless screw, $d^1$, governs the counter, *d*, and the latter automatically withdraws the lath, *z* (which guides the threads of the bobbin, F,) at the finish of each skein. The winding frame is also stopped by being automatically ungeared when the skein is complete. For this purpose the counter, *d*, at each revolution acts by a finger, $d^2$, on the lever, *g*, which causes another lever, $s^2$, with click, $s^1$, to oscillate; this latter engages in the teeth of a rack, *u*, screwed on the thread guide bar, *r*, and under the action of the spring, $s^3$, causes it to withdraw one tooth at each oscillation, or at each turn of the counter, *d*; this is the movement which divides or separates the skeins. Another lever, *x*, whose movements are solid with those of the levers, *q* and *t*, bears a click, $x^1$, which falls in the teeth of a sector, $y^1$, terminating one of the ends of the lever, *y*; the other arched end, $y^2$, of this latter rests on the spring or counterpoise, $z^1$, of the stopping mechanism, *z*. When the arch, $y^2$, escapes the rocker, *s*, the counterweight, $s^1$, draws by the articulation, $s^2$, on the crank, $s^3$, of the axis of the detent, *n*, and puts the brake, *s*, in action on the groove of the fly, *v*. The stoppage of the frame is instantaneous.

The second part of the improvements relates to the special arrangement for removing the skeins from above the windle without taking the latter from its supports, (see Fig. 3). The mechanism comprises a sector, R, $R^1$, T, moving on the axis, *o*, fixed at the head of the frame, $a^1$. The horizontal arm, R, supports the end of the axis of the windle, *b*, the other end of which receives the fly *v*. In the vertical

## AUSTRIAN BREWERY PLANT.

FIG. 36





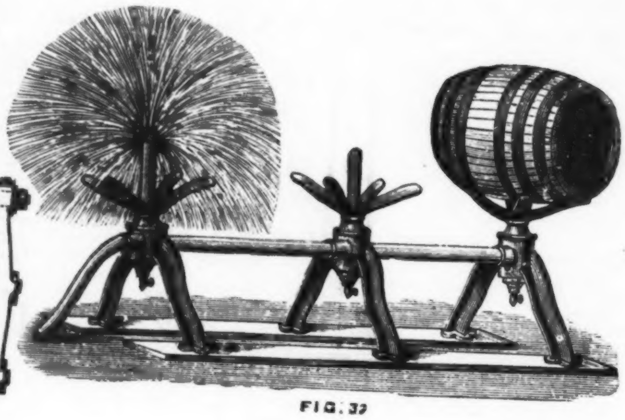


FIG. 37

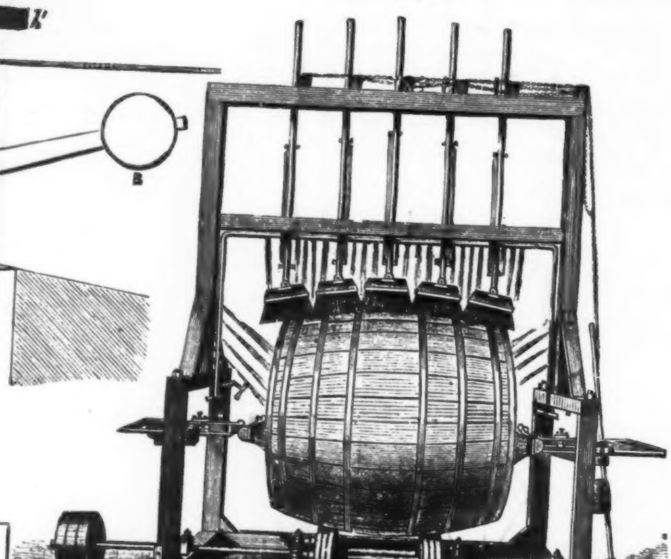


FIG. 38

FIG. 39

FIG. 40

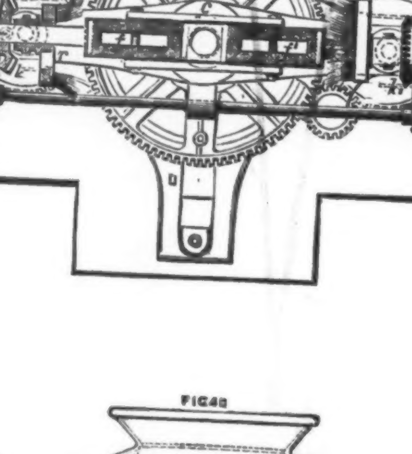
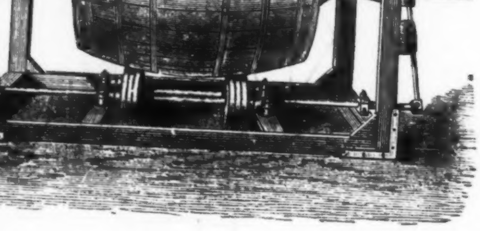


FIG. 41

FIG. 42



arm, R¹, a slide is made for the passage of a lever, M; this lever is fixed on the axis, H, as well as the lever, N, at the end of which is the support, Q. When the handle of the lever, M, is pressed the support, Q, raises and sustains the windle. The lever, M, reaches the end of the slide of the sector, the latter is no longer held, and falls in pivoting on the axis, o. The end of the winder is then disengaged, and the windle rests on the support, Q. The arc, T, of the sector prevents the lever, M, rising, and consequently of the support, Q, again falling.

To remove the skeins the following movement is made: Having turned back one of the staves of the windle to loosen the skeins, the latter are led to the space comprised between the support, Q, and the sector, R, R¹, T; the handle of the lever, M, is then pressed. The windle is sustained by the support, Q, and the sector falls. The skeins are removed altogether or partly, then it is only necessary to draw the button, w, of the sector to lead it to its primitive position. When the slide is opposite the lever the latter encounters and again retains the sector, consequently the end of the axis of the windle and the support, Q, again fall. —*Universal Engineer.*

## BREWING IN AUSTRIA.

HOWEVER good beer may be in the first instance, if it be stored in dirty barrels it will be ruined. In this country casks are washed by steam, and many ingenious machines have been devised for this purpose. Austrian brewery engineers have not stood still in this matter. We illustrate a set of cask washing machinery manufactured by Herr Ferdinand Scheil, of Frankfurt. This is a most successful machine, and thoroughly washes the barrels inside and out at the same time. The operation is as follows: The driving power —in Fig. 36 opposite—is communicated to the pulleys, *a a*, and through the spindles, *b*, to the conical wheels, *c c*, and the latter being keyed on the hollow vertical spindle, *d*, to which the frame, C C, of the actual washing apparatus is fixed, the barrel is rotated on its horizontal axis. The brush spindle, *e e*, with the articulated arms to which the two brushes, *f f*, are fixed, according to the shape of the barrel, remain at rest, and have only a vertical movement, which is rendered automatic by the lever, A, and the counterweights, B. As the main arms, C C, rotate, the two vertical spindles, *g g*¹, are set in motion by the two spur wheels, *h h*¹, gearing into the toothed rim, *i i*, resting on the block frame, D. Through the spindles, *g g*¹, motion is communicated to the conical wheels, *k k*¹, by which the spindles, *l l*¹, between which the barrel is gripped by the indented lips, *p p*¹, are driven, and the barrel made to revolve on its horizontal axis. The distance apart between the clips, *i. e.*, "the tension," is regulated by the hand wheel, *m*, through the pinions, *n n*¹, and the screw spindles, *o o*¹. The brushes, *r r*¹, for cleaning the ends, are kept against the barrel by means of the levers and counterweights, *q*. It will thus be seen that the barrel revolves on its vertical and horizontal axis at the same time, and, when half filled with water, is thoroughly washed out inside, while the exterior is being scrubbed on all sides by the brushes. The old methods are shown in Figs. 37 and 38.

Numerous machines for weighing grain automatically have been invented in various countries. We illustrate one invented by Herrn A. Kaiser, of Munich, which is considered very good in Austria. Fig. 39 represents the machine in its highest position, *i. e.*, empty and prepared for the inflow of the grain; Fig. 40 the position in which the beam is horizontal and the inflow opening reduced in area; and in Fig. 41 the actual scale is in its lowest position and the outflow fully open. The action of the apparatus is as follows: As soon as grain passes through the hopper the scale falls gradually from the position shown in Fig. 39 to that represented by Fig. 40. Here there is a short pause, during which the malt can only enter through the reduced opening. The scale hangs now perfectly free. As soon as a balance is attained the beam sinks, and, in doing so, closes the inlet, and the scale comes into the position shown in Fig. 41. The scale or weighing vessel empties itself in this position completely, and if the outflow clapper be not held open by any stoppage in the passage of the grain the scale returns automatically to its original position. Each operation is recorded by clockwork set in motion by the movement of the beam.

Fig. 42 represents the gauging apparatus recognized by the excise authorities. A is the apparatus, fed from the reservoir, B; *a* is the dividing plate; *b*, the float, which acts on the dividing plate by means of the cord passing over the rollers, *c, c'*; and *d*, the counterweight attached to *a* over the pulley, *c''*. *e* and *f* are the cocks between the apparatus and the barrels; *g*, a stop cock; *h*, the feed pipe; and *i*, a bent pipe with flat outflow, to prevent the water falling on the float. C is the barrel to be gauged, and D the drainage. The manipulation is self-evident from the engraving.—*The Engineer.*

## MACHINERY STEEL.

THIS term, as used in Sheffield, has now a much wider signification than it possessed a few years ago. The history of mechanical art undoubtedly comprises a full consideration of gradual changes in the employment of materials best suited for structures and for machines. It is a knowledge of these which imparts so much interest to gaunt and cumbrous devices, which, alas!—for the engineer as well as the professed archæologist may be allowed some sympathy with the past—are now rarely to be met with; where bulky wooden "arbors" and cog wheels of a quaint and primitive aspect proclaim unmistakably their origin *consule Planco.* During the early part of the present century, and even before railway days, a transition period—during which cast iron slowly displaced wood—occupied many years; and framework of a massive mediæval appearance gradually assumed outlines of greater lightness and elegance. Next came a nearer coincidence with the railway era; a greater development of wrought iron, which, for many purposes, and even for framework and columns, gradually pushed cast iron aside, especially when lightness in combination with strength had especially to be considered. Gradually in this way the fine Gothic framing which could be seen in the engine-rooms of large steamers propelled by side-lever engines—a "thing of beauty" in the eye of its Scotch designer but not destined assuredly to be "a joy for ever" —was displaced by comparatively light wrought iron columns and tie-rods, until that form of engine itself became obsolete and a thing of the past. The cast iron girders which were used for carrying railways over public roads and narrow streams were abandoned in favor of plate iron structures; while in the moving parts of the engines and machines, ponderous crossheads, connecting-rods, beams, and bars of every kind were formed of the more ductile material. It would be hard to assign a term to their process of development; certain it is that the need for lighter, stronger, finer material is more pressing than ever. The more the requirements of mankind are satisfied, the more do they seem to crave, and we have little expectation of seeing in our time any material which will be considered as leaving no more to be desired. During the last few years another very decided change has been going on in the gradual adoption of steel by both the civil and mechanical engineer. Steel steamships are now accomplished facts; and it is generally known that some of the most massive parts of their machinery, as shafts, propellers, pistons, and piston-rods, are frequently made from this material. Not only, however, has steel to a large extent displaced wrought iron, but it has deprived cast iron also of its *raison d'être* in many of the functions yet left to it. There seems to be a considerable prospect, in fact, that in a few years cast iron will be looked upon simply as the "first cause" of steel, unless, indeed—which is not improbable—we arrive at the manufacture of steel direct from the ore. Where hardness as well as strength are of prime importance, there has already been a very considerable substitution of steel in place of cast iron. In axle-boxes, horn blocks, slide blocks, and other such objects, steel is now largely employed by all our best engine-builders; nor have the advantages of employing steel castings for spur, bevel, and worm wheel gearing been less appreciated. For this last case it is not too much to say that there are many rolling mills for small rounds, wire, etc., which could not now be carried on at all to any profit but for the durability of the steel gearing by which they are driven. Not only is this the case, but with mills which are perhaps not so heavily tasked, such as ordinary 10 in. and 12 in. trains for rounds, squares, and spring steel, the application of steel gearing secures a great extension of efficiency. In the ordinary 10 in. train we have a pair of pinions of, say, 3 in. pitch and 12 in. broad, or formed, perhaps, in two steps each 6 in. broad. In the ordinary 12 in. train, the pinions are of 3¼ in. to 3½ in. pitch and 15 in. broad, or "stepped" in two lengths each of 7½ in. We do not find that such pinions, if made of the best cast iron, will run more than three years, if the mill be doing a fair amount of work; but it is certain that with steel gearing this endurance is at least trebled, and in all such cases we may expect, barring accidents, a life of from nine to ten years. This prolonged durability has led to the employment of steel gearing even on the very largest scale. Our attention has lately been drawn to a casting of this kind from the Grimesthorpe Foundry of Messrs. C. Cammell & Co., of Sheffield, which is larger than we imagined could as yet be produced in this country. This casting is a large spur wheel for a rolling mill in Scotland; it is 9 ft. 11¼ in. diameter at the pitch line, with a pitch of teeth=6$\frac{1}{16}$ in., and breadth of teeth=1 ft. 6 in. The diameter of the pinion supplied with this wheel—to Messrs. Turnbull, Grant & Jack, engineers, of Glasgow—was 3 ft. ¾ in. The weight of the steel wheel when cast was 16 tons, and when finished, between 13 and 14 tons, and of the pinion 48¾ cwt. We cannot but anticipate when we see such ponderous steel castings coming into use that we are still in the day of small things as regards steel. We believe this material will be more employed until in its turn it succumbs to the merits of some fresh metallurgical marvel yet in the unknown future. —*The Engineer.*

## THE MELBOURNE EXHIBITION.

THE official catalogue of the Melbourne International Exhibition, which opened in October last, has reached London. It is in two large volumes, comprising, with introductions, etc., about 800 octavo pages. The British section is described in a handsome illustrated portion of the catalogue, containing 857 industrial entries, many single entries being of a very large extent, as, for instance, the iron collections from the works of Lord Dudley, Lord Granville, Messrs. Barrows & Son, and Messrs. Hingley, in addition to 567 oil paintings, water-color drawings, sculptures, architectural sketches, etc. The Italian art collection comprises 429 designs and paintings, and the French 255, exclusive of the groups from the national workshops of Beauvais, the Gobelins, and Sèvres. Belgium has an entry of 122 works of art; Germany, 139; and Holland, 18. The Australian Colonies themselves exhibit to a considerable extent in the fine art section, New South Wales sending 67 entries, Tasmania 15, Queensland 18, New Zealand 79; while Victoria, the colony in which the Exhibition is held, contributes 447. In the industrial section, the United States appear as making 364 entries, but some of the objects sent were destroyed by casualty at sea. By the similar accident which overtook some of the English consignments by the Sorata, only one collection, that of the Kirkstall Forge Company, was totally lost. The Indian exhibit is a large one, Bombay contributing 42 entries, the Presidency of Bengal 108, Berar 24, the Northwest Provinces 101, and the Punjab 46. The industrial exhibition of Victoria itself reaches 1,828 numbers, including "The Ladies' Court," which contains about 200 groups of wool flowers, painted screens and furniture, lace and fine art needlework, fretwork, skeleton leaves, straw work, etc., all produced by ladies, for the purpose of rendering the Exhibition a creditable one to the colony. Western Australia sends vegetables, fruit, and raw materials of various kinds, etc.

New South Wales, which held its own exhibition last year, has 297 industrial entries, while New Zealand has 511, Queensland 545, and South Australia 232. The different methods adopted in tabulating objects or collections, and the variations in quality of the articles exhibited, prevent a comparison of numbers from furnishing materials for exactly appreciating the representation of each country and colony at the Exhibition, and the figures only supply an approximate test. But after the near Australian Colonies the other British dependencies display, as might be expected, a marked falling off in numbers, Mauritius sending 84 entries, the Straits Settlements 95, the Cape and Jamaica 5. Japan has no less than 154; China only 15. On the other hand, some of the European countries have manifested great activity. Germany, whose Chief Commissioner was Professor Reuleaux, has 845 entries in the industrial section, only 12 less than the mother country, while France contributes 898, actually more than England, and these numbers do not include the collections of the Ministry of the Interior and of the General Departmental, Communal, and Penitentiary Administrations (49 numbers). The Italian entry is 618; the Dutch 71. The Austrian list had not come to hand at the time of the issue of the catalogue, which was to be had, with rare and commendable punctuality, on the opening day of the Exhibition. Switzerland has 50 entries; Russia, Turkey, Sweden, Norway, and Denmark have an insignificant exhibition, and a similar remark applies to Spain, Portugal, and their colonies, or the independent Republics formed from their colonies. The British section is particularly rich in textiles, pottery, and metallurgy. The Prince of Wales is President of the English Commission, which acted also for the Sydney Exhibition last year; and Sir Herbert Sandford represents the Commission in Melbourne.—*London Times.*

## MACADAM VS. CEDAR BLOCK.

MAYOR HARRISON, of Chicago, is, it is well known, a fanatical—and, it is said, not entirely disinterested—admirer of macadam as a road material. A few days ago he vetoed a by-law authorizing the paving of Ashland avenue with wooden blocks. In imposing his veto he directed the attention of the council to the advisability of adopting macadam. An attempt was made to pass the by-law over the veto, but it failed to receive the necessary two-thirds vote. Mr. Harrison was, at the late election, defeated, and he will retire from office at the end of the year. His crotchets about macadam are supported by very few of his people. The Chicago *Tribune* remarks:

"Mr. Harrison does not seem to make the distinction which ought to be made between the various styles of wooden blocks and the methods of laying them. There were many miles of pine block pavement laid during a number of years which were defective, both in material and in construction. The rapid decay of these white-pine pavements is not, however, a sufficient reason for abandoning the whole system of wooden blocks. It has been proved to be satisfactory in other cities, notably Detroit, where it has been in use eleven years. Cedar blocks laid upon a proper foundation constitute a very durable and economical, as well as a smooth and noiseless pavement. To the extent that this cedar block has been used in Chicago, the test promises equally favorable results. There are now in the city cedar block pavements that were laid six years ago, and, after enduring heavy travel, are still in quite good condition. They ought not to be classed with the pavements which were composed of wet, unsound pine in the first instance, and were hurriedly planted in loose earth."

In the same journal a correspondent, who seems to know what he is talking about, says:

"In order to keep a roadway made of this macadam in any condition it must have continuous attention, and, while costing but little at first, it soon becomes an expensive pavement, owing to repeated repairing. From three years' observation of this kind of pavement, I am led to think that its adoption on Ashland avenue, or upon any street in the city, would not meet with the public approval sought for, but that it would be productive of censure well merited."

An overwhelming mass of evidence showing the complete failure of macadam on this continent could be easily adduced. The experience of Toronto alone is enough utterly to condemn it. In Toronto we have spent more than $10,000,000 in macadamizing streets, which become seas of mud after a few hours' rain. Positively we should be better off at this day if one of Aladdin's genii would take up our macadam for us and drop it in Timbuctoo. Yonge street must have had a full million dollars' worth of macadam put upon it. The roadway has been a wretched failure all through its history, and now it is to be paved with cedar blocks. It will actually cost the inhabitants thousands of dollars to get rid of the macadam and put themselves in the favorable position they would occupy if there were only a dirt road to be dealt with. The contract price of laying cedar blocks on Yonge street is $1.19 per square yard. On Wellesley place, a dirt road, it is 77 cents, on North Ontario, with a sand road bed, 69 cents per yard. It is a pity we cannot sell our macadam *in situ* to Mayor Harrison.—*Toronto Globe.*

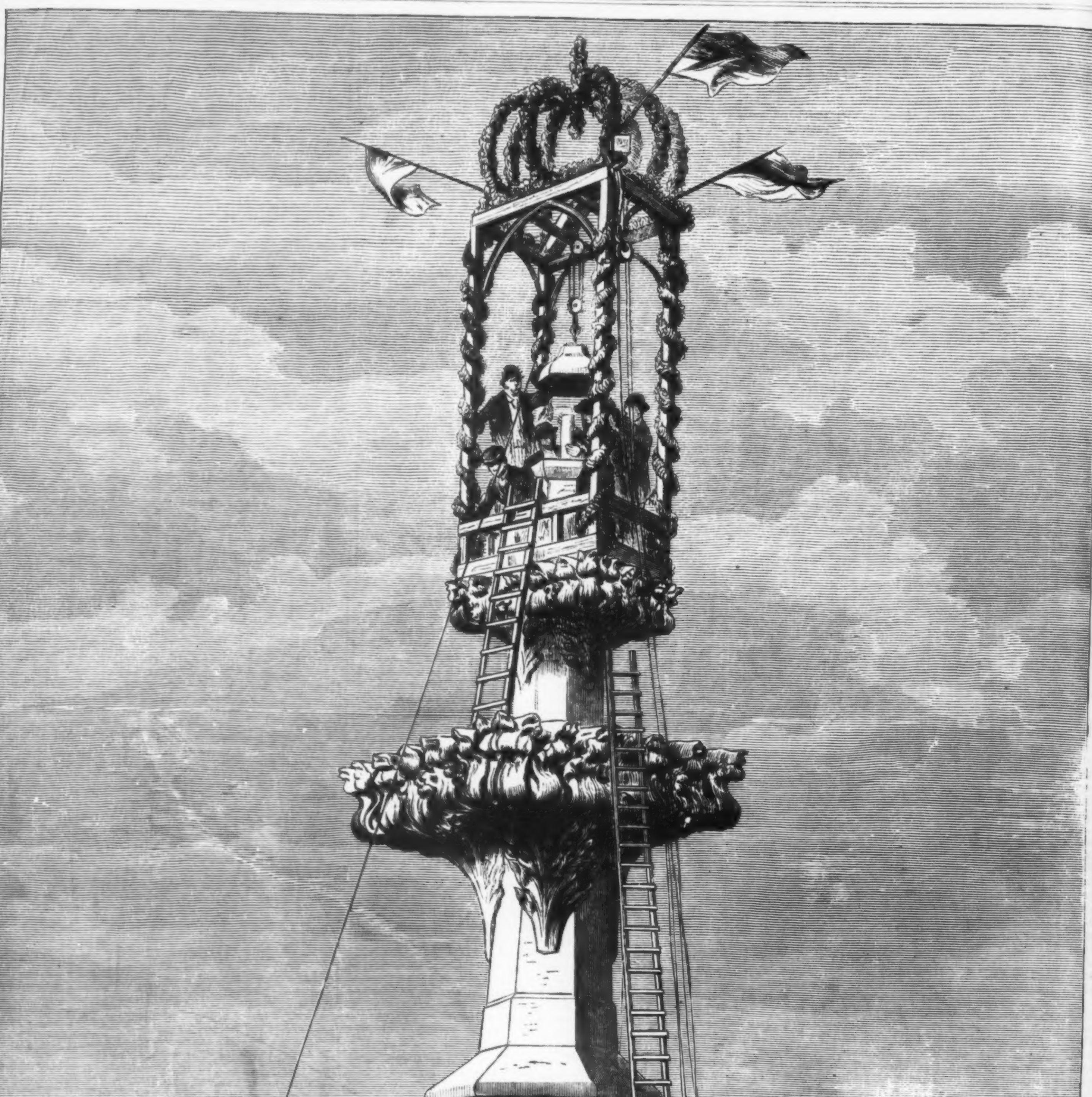
## FROSTS AND AUTUMNAL TINTS.

MR. WILSON FLAGG, the popular writer on New England birds and by-ways, waxes indignant at the inattention of intelligent people to out-door matters, and deprecates the excess of literary reading characteristic of New England life. He says:

Millions of people are constantly employed in reading, while not one in a thousand knows this most obvious fact that the tints of the forest are the result of the perfect maturity of the leaves, and that frost, be it ever so slight, destroys the tints of every leaf it touches. How shall we explain this want of correct observation? It is owing to their voluminous reading, which leaves them no time for observation; and, to prove my assertion, I would call attention to the fact that these and other similar things appertaining to nature are well understood by many English peasants who have never learned to read. Our people might learn this and similar matters from books if they looked into the books that contain them. But all, educated and uneducated, confine their reading almost exclusively to literature. The well educated can quote from the poets and the German and Concord philosophers; they can criticise all the novels of the day; they can understand Prof. Gray's books on the physiology of plants; they are able to write brilliantly and talk as well; but they are ignorant of everything concerning nature that depends on observation. The studious are more numerous than the observers. They may even have studied Mr. Gray's books till they have mastered their contents, and yet fail to understand that frost is not the cause of the tints of autumn. But, it may be asked, why do not Prof. Gray's books contain this fact? Because they treat only of science, and the subject of these remarks is a matter of observation, not of science. Science and literature are taught in our colleges, but I have known many a graduate who was unacquainted with this fact regarding the autumnal tints, and I am not sure that I was ever acquainted with more than two or three that knew it. I suppose the ladies of our "field clubs" are acquainted with this obvious fact, because they pursue their studies out of doors. They are not confined to books. I believe it was the English philosopher Hobbs who said that he knew more than his contemporaries because he had not read so many books. This was rather the cause of his greater clear-headedness. Sparse and select reading clears the head and sharpens the observation; voluminous reading obfuscates the intellect, and leaves no time for observation, but it makes brilliant writers.

## UNINFLAMMABLE TISSUES.

THE French Société d'Encouragement pour l'Industrie Nationale has awarded to M. Martin, of Paris, a prize of 1,000 francs for his preparations for rendering wood and textile fabrics uninflammable. For wearing apparel, etc., a mixture of sulphate and carbonate of ammonia, boracic acid, borax, starch, and water is used, and several other preparations for similar uses are described.



THE GREAT COLOGNE CATHEDRAL.—PLACING THE CAP-STONE OF THE SOUTH SPIRE.

## PLACING THE CAP-STONE UPON THE FINIAL OF THE SOUTH TOWER OF THE CATHEDRAL IN COLOGNE.

THE opposite cut represents the last act of the great ceremonies that have taken place during the celebration of the completion of the Cologne Cathedral.

The document of inauguration, portraits, coins, and several manuscripts were placed in a metal cylinder, which was inserted in the finial of the south tower, and finally the capping stone was lowered upon the finial amid the thundering of cannon, the ringing of bells, and the cheers of the multitude.

In our SUPPLEMENT 257 we gave two large engravings representing the architecture of the great building, with a general history of the structure; and in SUPPLEMENT 259 we presented an interesting description, from the pen of a special correspondent at Cologne, of the remarkable historical procession that lately took place there, in connection with the final festivities.

MIRROR FRAME IN WOOD CARVED AND GILT, BY FR. SCHŒNTHALER, VIENNA.—*From the Workshop.*

## COOKING BY HOT WATER.

A LARGE number of the members of the American Society of Civil Engineers lately visited the building occupied by the Prall Steam Heating and Cooking Company in One Hundred and Twenty-fifth street, near Eighth avenue, this city, where a lunch was prepared for them by the company. As each member of the society entered the place he was asked to walk back to the range at the rear of the room, where two plump turkeys were roasting.

After a few minutes Mr. W. E. Prall, the inventor of the system, mounted a chair and delivered a short speech describing the company's methods. He said:

"Our system of cooking is not by the use of steam, but by superheated water. Everything you see upon the table here was cooked in our range. Some of the companies which have tried to use steam for cooking have been compelled to abandon the plan, as it has been found impracticable. Our plan in a few words is this: We send out from our stations, through pipes about three or four inches in diameter, a constant stream of water heated to the temperature of four hundred and thirty-five degrees. This hot water is conducted by smaller pipes into the house. Here it branches, and one pipe leads to a converter, where the hot water is converted into steam and distributed to the radiators and heaters in the building, making about five hundred times its volume in steam. Another pipe leads directly to the range.

"At the side of the range is a valve with an aperture the size of a needle, through which the hot water passes into a pipe having an inside diameter of about a quarter of an inch. This pipe is coiled around the top, bottom and two sides of the oven. A casting of iron is placed both inside and outside of this coil of pipe. Upon the top of the oven are stationary pots, and meats and vegetables can be cooked either in these or in ordinary pots. At the back of the oven a coil of pipe is arranged for boiling.

"All that is necessary when the oven is needed is to turn the valve, and in five minutes the oven will be ready. With a wood or a coal fire the greater part of the heat passes up the chimney, but with this system we keep all the heat about the oven, and the water, after doing its work there, passes with no diminution in heat to a boiler or tank, and thence to all parts of the house where it may be needed for washing purposes. When the range is not needed the valve can be shut, and the water passes directly to the tank through another pipe."

After this explanation the visitors were requested to make themselves at home, and no second invitation was needed. In the center of the room a long table was arranged upon which were displayed turkeys and spring chickens deliciously browned, roast beef done to a turn, broiled lamb chops, crisp and juicy, and corned beef, with vegetables of many kinds. Every dish on the table was cooked in the room in the oven of the company.

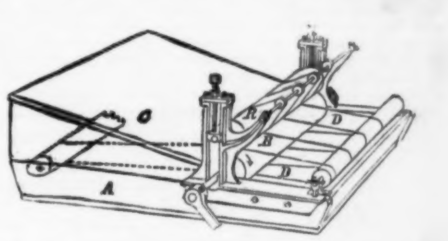
Despite the fact that this oven was ready for cooking anything from a loaf of bread to a joint of beef all the time the guests were in the room, no heat came from it, except on the top, where places for kettles for boiling, and a row of pipes for broiling purposes, were placed. The sides and door of the oven were cool enough to rest one's hand against.

The company also had a number of ovens ranged at the rear of the room which were not in use, so that the visitors could examine more closely their arrangement for cooking.

## LABELS, TABLETS, OR SHEETS FOR ADVERTISING, ETC.

By A. McCAW, J. STEVENSON, and J. P. ORR, Belfast, Ireland.

RELATES to the manufacture of transparent paper or cloth to take the place of the glass advertising tablets at present used, and for imitating the gelatine covers employed for wrapping confectionery, and for other purposes. Thin hard glazed paper is selected, and on it is printed the letters or device required. If the tablet is to be transparent, the colors must be prepared from "transparent pigments." The letters or other parts which are required to be protected from the action of the varnish, and which are designed to show by reflected light, are printed with Kremitz white or

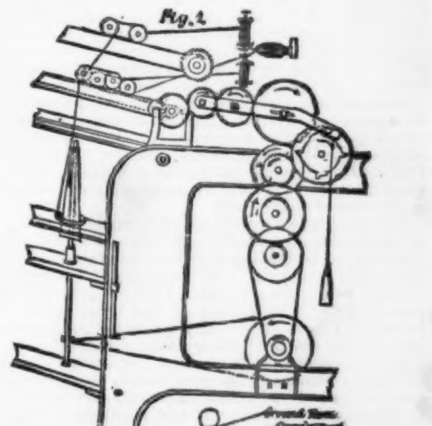



white lead. After the ground work has been printed in transparent colors, and the letters as described, the sheets are dried, and passed through a machine which contains a bath of copal, carriage, or spirit varnish. After a second drying they are passed through a solution of gum arabic and sulphate of aluminum, or other adhesive compound, and are then cut and made ready for affixing to windows. For opaque tablets the same process is adopted with the use of opaque colors and furthermore fibrous materials may be treated to resemble woods, inlaid work, etc. Imitation gelatine sheets are merely varnished. The illustration shows the varnishing and gumming machine. A is the bath, B R the feed rollers, the lower one of which runs in the liquid, D D, traveling bands that lead the sheets to and from the rollers.

## MANUFACTURE OF SPOT YARNS.

By G. A. J. SCHOTT, Bradford, England.

THE yarn is made of two or more continuous threads, and of a number of short detached pieces of soft slubbing or roving, so twisted together that at certain determined intervals globular or spheroidal knobs or protuberances are produced, all or some of which contain either a color or material, or both, not contained in the intervening space between such knobs. The yarn which forms the core of the thread is called the ground, the other continuous yarn or yarns the carriers, and the soft pieces the float. (2) A frame



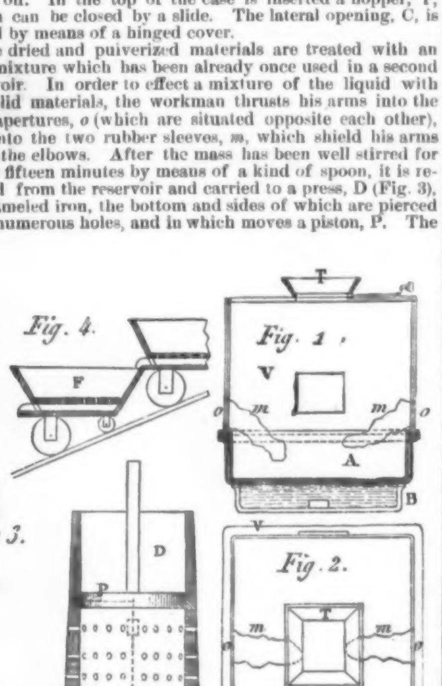

or machine for manufacturing such spot yarn is shown in the illustration, which appears to be partly in elevation and partly in perspective view. It is similar, with the exception of the rollers and roller driving mechanism, to ordinary spinning and doubling frames. The rollers are shown diagrammatically below and in position in Fig. 1, the carrier rollers being driven continuously, and the ground and float rollers intermittently one at a time accordingly as the driving wheel is in gear, under the action of the cam-plate with either roller-wheel, or they are both stopped when the driving wheel takes an intermediate position. The distance between the centers of the carrier and float rollers must be

greater than the average length of the fibers of the float yarn, so that the said yarn may be easily severed or drawn out when its rollers are stopped. In operation when forming the part of the thread between the knobs, the ground and carrier yarns are fed out equally to be twisted by the spindle and wound on the bobbin by the flier or traveler; at the proper point the ground rollers are stopped and the float rollers started and the carrier and float yarns twisted around the rotating, but not advancing, ground yarn to form a knot. When the knot is sufficiently large the ground rollers are started again, the float rollers stopped, and the float yarn pulled apart by the carrier rollers. To gain different effects the float yarn may be introduced into some knobs and not into others either in regular or irregular order, in which case the cam-plate must be suspended by a more complicated appliance.

## APPARATUS FOR MANUFACTURING CELLULOID.

In order to prepare the mixture of nitro-cellulose and camphor which has been called celluloid, Messrs. Tribouillet & Besancèle desiccate the materials (paper, cotton, flax, hemp, white wood, etc.) at a temperature of 100 degrees, pulverize it properly, and then nitrate it. The latter operation is performed in an apparatus represented in the annexed Figs. 1 and 2, and which is composed of reservoirs 5¼ to 7½ inches in height, constructed of glass, earthenware, or enameled iron. These reservoirs rest on a hollow support, B, through which water is constantly kept circulating in order to cool the bottom, A, of the reservoir. On top of each of them is placed a glass case, V, for protecting the workmen against the vapors which are given off. In the top of the case is inserted a hopper, T, which can be closed by a slide. The lateral opening, C, is closed by means of a hinged cover.

The dried and pulverized materials are treated with an acid mixture which has been already once used in a second reservoir. In order to effect a mixture of the liquid with the solid materials, the workman thrusts his arms into the two apertures, o (which are situated opposite each other), and into the two rubber sleeves, m, which shield his arms up to the elbows. After the mass has been well stirred for ten to fifteen minutes by means of a kind of spoon, it is removed from the reservoir and carried to a press, D (Fig. 3), of enameled iron, the bottom and sides of which are pierced with numerous holes, and in which moves a piston, P. The




mass, after being taken from the press, is then put into another mixer and treated with a mixture of three parts sulphuric acid (density 1·834) with two parts of concentrated nitric in which has been dissolved some nitrous acid. Afterwards the liquid is again expressed as before. The liquid which flows off is poured into the first reservoir, to be therein again mixed with fresh cellulose. To strengthen this liquid there may be added to it concentrated sulphuric acid or dry sulphate of soda. The expressed nitro-cellulose is mixed with water and then placed in double-bottomed wooden vessels, F (Fig. 4), which are mounted on wheels of unequal diameter, and which are caused to ascend an inclined plane, while the water as it flows out descends successively from one vessel into the other. The acid that remains is removed by water containing in solution a small quantity of soda or ammonia. Lastly, the product is again washed with water.

The acids which can no longer be made use of for treating the cellulose may be utilized in different ways. They may, for example, be employed in the manufacture of sulphuric acid. The water which has been used for washing may be utilized in the manufacture of oxalic acid, dextrine, as a mordant, etc. The acids may also be saturated with carbonate of lime, and the soluble nitrates collected, purified, evaporated, and put into market. Or finally, the nitrates may be treated with sulphate of soda or potash, to obtain crystalline nitrates. The pyroxyline obtained by the above method is preserved under water, and then dried. In order to manufacture translucent and transparent objects, it is treated with the proper solvents, which afterward are removed by distillation. In this manner a pasty mass is obtained which may be moulded and afterward thoroughly dried. To imitate ivory and for opaque objects of this nature, powdered camphor is employed, 100 parts of pyroxyline are intimately mixed with from forty-two to fifty parts of camphor, the mixture is wrapped up in a very stout cloth, and is then put into a hair-cloth bag which is compressed between the plates of a press. Steam is admitted into the hollow sides of the press, which is surrounded by a jacket of iron. The press is connected with a chamber in which water is caused to flow in order to condense the vapors given off during compression. After one or more hours, the cakes remaining in the press may be placed in a heated cylindrical press, and then in an apparatus with a capacity of about three cubic centimeters containing chloride of calcium or sulphuric acid, for the purpose of absorbing the steam. After the apparatus has been filled a vacuum is created therein by means of an air-pump, in order to hasten desiccation. The thin plates obtained in this way are afterwards treated by ordinary processes. To render the pyroxyline non-inflammable, it is washed in a solution of silicate of soda, then mixed with phosphate of soda or ammonia, borate of lead, or, finally, with the most fusible fluxes that are used in glass or porcelain painting.

[Continued from SUPPLEMENT No. 264, page 4207.]

## ELECTRIC LIGHTING.*

In all the various attempts to utilize the principle of the incandescence of carbon in vacuo two great difficulties has stood in the way and baffled every attempt to overcome them. One was the rapid wearing away and consequent breaking of the incandescent carbon; and the other the obscuration of the lamp by a kind of black smoke. So uniformly did these phenomena present themselves that the idea was propounded and generally accepted that the blackening of the lamp globes was due to volatilization of the carbon under the action of the enormous heat to which it was subjected.

In Fontaine's work on electric light this passage occurs at page 180:

"Attentive examination of incandescent carbons through a strongly colored glass has shown that they are not uniformly brilliant. They present obscure spots indicative of non-homogeneity, and the position of cracks, which rapidly disintegrate the carbon. The vacuum never being perfect in the receivers the first carbon is in greater part consumed. It would appear that, consequently upon the little oxygen contained in the lamp being transformed into carbonic acid and carbonic oxide, the carbon should be preserved indefinitely. But there is then produced a kind of evaporation which continues to slowly destroy the incandescent rods. This evaporation is, besides, clearly proved by a pulverulent deposit of sublimed carbon, that we have found on the interior surface of the bells, on the several interior parts, rods, contacts, hammers, etc."

If this idea of the volatilization of carbon were founded in fact, any further attempt to render incandescent carbon lamps durable by means of a vacuum were mere waste of time, and durable they must be if they were to be of any practical value.

Fortunately, I did not accept as conclusive the experiments which seemed to show that carbon was volatile, and that the blackening of globes of incandescent carbon lamps was an inevitable result of the carbon being very highly heated. I knew that the conditions under which, without exception, all previous experiments had been tried, were such as did not allow to be formed anything approaching a perfect vacuum within the lamp. Screw fittings had invariably been employed to close the mouth of the lamp, and the ordinary air pump to exhaust the air. Under such circumstances it was certain that a considerable residuum of air would be contained within it, and also that it would leak. Then, there had never been any thought given to the gas occluded in the carbon itself, and which, when the carbon became hot by the passage of the current through it, would be evolved; nor had sufficient care been taken to make the resistance, at the points of fixture of the carbon, less than in the carbon to be heated to incandescence.

It was evident to me that before any definite conclusion could be arrived at as to the question of the volatility of carbon, the cause of the blackening of the globes, and the wearing away of the incandescent rods, we must first try the experiment of heating the carbon to a state of extreme incandescence in a thoroughly good vacuum (such as Mr. Crookes had taught us how to procure), and under more favorable conditions as to the contact between the incandescent carbon and the conductors supporting it than had hitherto obtained.

Accordingly, in October, 1877, I sent to Mr. Stearn a number of carbons, made from carbonized cardboard, with the request that he would get them mounted for me in glass globes by a glass blower, and then exhaust the air as completely as possible. This delicate operation Mr. Stearn very kindly undertook and very skillfully carried out.

In order to produce a good vacuum it was found necessary to heat the carbon to a very high degree by means of the electric current during the process of exhaustion, so as to expel the gas occluded by the carbon in its cold state, for, otherwise, however good the vacuum was before the carbon was heated, immediately the current passed and made it white hot, the vacuum was destroyed by the outrush of the gas pent up in the carbon in its cold state. In order to make a good contact between the carbon and the clips supporting it, the ends of the carbon were thickened, and, in some of the early experiments, electrotyping and hard soldering of the ends of the carbons to platinum was resorted to.

I will not weary you, however, with details, but simply say that the prescribed conditions having been rigorously complied with, it was found, after many troublesome experiments, that when the vacuum within the lamp globe was good, and the contact between the carbon and the conductor which supported it sufficient, there was no blackening of the globes and no appreciable wasting away of the carbons.

Thus was swept away a pernicious error, which, like a lying finger post, proclaiming, "No road this way," tended to bar progress along a good thoroughfare.

It only remained to perfect the details of the lamp, to find the best material from which to form the carbon, and to fix this material in the lamp in the best manner. These points, I think, I have now satisfactorily settled; and you see the result in the lamp before me on the table.

It is a very modest looking affair, but its performance goes beyond its appearance. The carbon is extremely thin—a mere hair—and how wonderfully strong and elastic it is I will endeavor to show you by means of the lantern.

This carbon, unlike the carbon spoken of by Fontaine in the extract I read to you, is quite homogeneous and almost flinty in hardness, and it becomes harder by the use in the lamp; the longer and the hotter it is heated the harder it becomes. What degree of hardness it will ultimately arrive at is an interesting question.

Here is a magnified view of the carbon ring in a state of incandescence. Observe how absolutely uniform in brightness it is; that proves it to be homogeneous, and foretells its durability.

Now I will show you how easily lamps of this kind are lighted, and how completely this form of electric light can be divided and distributed.

Is it not a pleasant light? It is not so white as the arc light, but yet a whiter light than gas. Colors are correctly seen by it as this picture shows. But the great merit of this light consists in its not being in contact with air, and, therefore, there cannot possibly be the slightest air pollution caused by it. The rooms in which this light is used will be as pure by night as by day.

It is essential to economy in lighting by incandescence that the incandescent carbon should be very thin. The carbon I use is not one-twentieth of the thickness of the thinnest of the carbons formerly employed, and, therefore, one-twentieth of the current, costing one-twentieth the price, will produce in my thin carbon the same degree of luminosity as twenty times more current will produce in such carbons as were used in those ancient lamps.

You will notice that in my lamp leakage is very thoroughly guarded against. The wire which passes through the glass not only having the glass fused around it where the wire and globe meet—but in addition to this, the wire is coated with glass almost up to the carbon. In this way the vacuum is preserved very effectually.

You have, of course, all heard that after Mr. Edison abandoned his platinum lamp as impracticable, he invented a new lamp in which carbonized cardboard is used.

Here is a diagram of Mr. Edison's carbon lamp, with its horseshoe of carbonized paper. It is in some respects like mine, but latterly I have given up the use of carbonized cardboard, and am now using a material as much better than carbonized cardboard as carbonized cardboard was better than the material previously used. In an article which appeared in the February number of *Scribner's Magazine*, authenticated by a letter from Mr. Edison in the same publication, it is stated that Mr. Edison was the first to use carbonized paper; that is incorrect. And this also occurs after a description of the Sprengel pump used in exhausting these lamps: "Mr. Edison's use of carbon in such a vacuum is entirely new." Now, I daresay, there are many here who will remember this little lamp, which I showed here two years ago in action. This lamp has exactly the same simplicity as my present lamp, being composed entirely of three substances, namely, glass, platinum, and carbon, and it was exhausted in precisely the same manner, and to the same degree, as that which Mr. Upton—no doubt in good faith but still in error—speaks of as "entirely new."

I do not mention these things in any way to disparage Mr. Edison, for no one can esteem more highly his inventive genius than I do. I merely state these facts because I think it is right to do so in my own interest and in the interest of true history.

The complete seclusion of the light in this lamp from contact with air suggests its adaptability to coal mine illumination, and I earnestly hope that this may prove to be one of its uses.

But the great purpose to which a lamp of this kind is applicable is the lighting of your houses. In view of such an application two all-important questions present themselves—one as to distribution, another as to cost.

Can this light be divided, distributed, and measured as gas is divided, distributed, and measured? And at what cost? It is quite impossible in a brief lecture to discuss these questions exhaustively, but as far as is possible, in a few words, I will answer them.

First, then, as to division and distribution, it has been asserted on very high authority that great loss necessarily attends the division of the electric light. To a certain extent this is true of lighting by the electric arc, but it is totally and absolutely erroneous of lighting by incandescence. There is no loss in dividing the electric light produced by this means. Faraday has stated the law of the case in these words: "An electric current which will heat one inch of wire white hot, will also heat to the same temperature 100 inches, or an infinite length of the same wire." There is no question of the truth of this. Now, as it is only necessary, in order to maintain a given current, to increase the force which produces it in the same proportion as you increase the resistance to its flow, it follows that the cost of raising to a certain degree of incandescence a longer or shorter length of carbon, or of maintaining a 10-candle light or 100-candle light, will be exactly proportional to the light produced. You may even contemplate on this principle the economical production of an electric light as small as a rush-light. A certain unit of light may be established in an indefinite number of places, with no greater aggregate expenditure of power than that directly and simply proportional to the number of lights.

With regard to distribution, I believe that it will prove to be practicable to light any large town—all Newcastle, for instance—by means of wires laid in the ground as gas pipes are laid, and all branching from one center, and conveying the electric current to lamps like this.

The lamps now lighted are supplied by a current coming from generators working at the far end of Mosley street (a quarter of a mile away), and it would be just as easy by using a more energetic current—a current as it were under higher pressure—to maintain these several miles away, and for this purpose the conductors need not be large, not so large certainly as to make the distribution of electric current more costly than the distribution of gas.

For supplying large towns with electric light, Mr. Edison proposes to have a number of centers for the supply of electric power, perhaps a quarter of a mile apart, whence wires would be sent out in every different direction, distributing the current to the houses round about. His plan of distribution is this. He proposes to send out bundles of main wires from each of the centers of supply, and from these main wires to branch as many small wires into the houses as there are lamps to be lighted, each branch wire proceeding from a main wire to the place where the lamp is situated, and from thence to a return main wire.

Now, although this plan has the great merit of simplicity, I do not think it will answer, except for very short distances.

When a number of lamps are grouped together in that manner, it is necessary that the individual lamps should offer a very high resistance to the current, for if each lamp does not offer an extremely high resistance to the passage of the current there must be great waste, a large proportion of energy being in that case spent in heating the conducting wires, instead of the carbon in the lamps.

Mr. Edison accordingly proposes to make his lamps of a very high resistance; he proposes to use for the incandescent material a form of carbon which offers a higher resistance than simple carbon in its compact state; but if carbon pure and simple is used, then I submit it had better be in as stable and condensed a state as possible, because in process of use it tends to consolidate, and it is undesirable that any change should take place in the lamp during use.

The resistance offered by a filament of carbon in its best state for incandescent lamps, as thin as it is safe to use in a lamp, and of a length sufficient to give, say a light equal to one burner, or ten standard candles (a unit of light which I think we must not go beyond in planning an extensive system of town lighting) will not offer so high a resistance as that which Mr. Edison has made the basis of his scheme of distribution.

With lamps of this resistance, the result would be that

* Abstract of a lecture delivered by J. W. Swan, at the Literary and Philosophical Society, Newcastle-on-Tyne, October 20, 1880.

before many were bridged across from one main wire to another, as much or more work would be done in the conducting wire as in the lamp. The only way of avoiding this waste of energy, without abandoning the idea of small units of light, would be either to employ enormously thick conductors, or have a very limited area supplied from one works.

I think the difficulty is capable of being surmounted in this way: Instead of grouping the lamps as Mr. Edison proposes, each lamp being as it were a loop or bridge between two mains, I propose to string them in series—10, 50, or perhaps 100 lamps being all interposed in one and the same line. In this way every lamp would add to the resistance of the line instead of, as in Mr. Edison's plan, diminishing its resistance. The waste of energy in the conducting wire would thus be avoided.

A copper wire, less than one eighth of an inch thick, would supply current for one such series of, say from 10 to 100 lamps, at five miles distance, with a very small percentage of loss; while to supply at the same distance a corresponding series on Mr. Edison's plan would demand copper conductors of such thickness as would certainly make the plan far too expensive, or, if such thick conductor was not used, there would be an impracticably extravagant waste of energy in the wire. If even 50 per cent. of the energy were expended in the wire, the size of the conductor required to transmit the current, say even two miles, would be far too great.

There is no way of escape that I know of from this dilemma, viz.: that either we must make our unit of light larger than necessary for a very great many purposes, and so give up the idea of extensive division and extensive distribution, or, in order to gain these points, we must group the lamps in the manner I have proposed.

There are, no doubt, difficulties in the carrying out of my plan, but none that are not easily surmountable. For example, if 20, 50, or 100 lights were in a series, a break in any part of the line would extinguish all the lights. This danger can be met in two ways:

I would have only one lamp belonging to a given line in one house, so that the extinction of such a line of lights as we are contemplating would not be a very serious mishap; but I would make such a mishap extremely unlikely to occur, by placing along with each lamp an automatic circuit closer. This would so act as to bridge over the gap made by the accidental breaking or failure of a lamp, and so prevent the extinction of the rest of the lamps in the series, while a fresh lamp was put in the place of the broken one—a thing no more difficult, and probably not more costly, than the replacement of a broken gas chimney or globe.

There is another difficulty occasioned by the variation of the current in proportion to the number of lamps in action.

What is required in this case is to maintain a uniform current in the line of lamps, whether 1 or 100 are alight. This can be accomplished by self-acting apparatus somewhat on the principle of the governor of the steam engine, and which would automatically raise or lower the potential or pressure by steps of one-hundredths, according to the number of lamps in use.

I have also considered the question of measuring the current, and, if time allowed, I could show you that that could be done as easily as the measuring of gas.

Similarly, all other practical difficulties arising out of this method of distribution can be met, and being met, we are at liberty to contemplate a great central works producing electricity by large steam engines, and distributing it by means of wires to a whole town, exactly as gas is now distributed by gasworks.

I have already referred to the cost of electric light produced on the arc principle, and shown that when the circumstances are favorable to the employment of that method it is much more economical than gaslight.

The economy of lighting by incandescence has not been exemplified by so many instances of actual practical use. One thing is, however, quite clear, and that is, that electric lighting by incandescence is an economical process—it will be less costly than gas lighting. That is conclusively demonstrated by the fact that the 1,000 feet of gas employed in working a gas engine to develop an electric current, and used in my lamps, will yield more light than 1,000 feet of gas consumed in the ordinary way in gas burners. This room is now lighted by twenty of my electric lamps, and to produce the current which feeds them 160 cubic feet of gas per hour are being burnt in a gas engine; before my lamps were kindled the room was lighted by 70 gas jets, consuming, I am told on good authority, 280 feet per hour. It is very evident that we have got more light out of the gas through the medium of electricity than was got from the larger quantity of gas which those burners consumed. Our conditions here are somewhat unfavorable to my light for a fair comparison, but from measurements carefully made, both of light produced and current required to produce it, I am warranted in saying that at least twice as much light will be produced by a certain quantity of gas used to generate an electric current employed in my lamps as would be obtained from this quantity of gas burnt in gas burners in the usual manner.

If that is so, then it is evident that when, instead of the motive power of gas, that of steam produced in the most economical manner is employed, this method of electric lighting will be very much less costly than gas lighting. I reckon that 40 lb. of coal employed in raising steam to generate electricity is capable of producing in my lamps the effect of 1,000 feet of gas burnt in gas burners in the ordinary manner.

The economical view of the question is therefore, in my opinion, very favorable to electric lighting, and I think fully warrants me in anticipating an extensive substitution of electric light for gas light.

The great difficulty which till now has completely blocked the way to any general use of electric light was the difficulty of division. That difficulty is now completely overcome, by the method of producing electric light by the incandescence of carbon in vacuo of which I have given you a practical demonstration to-night.

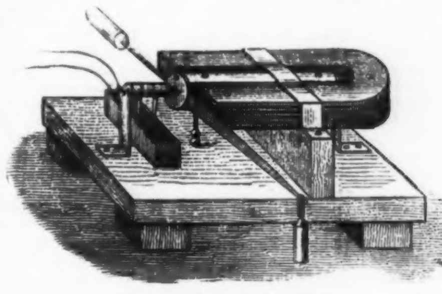
Now, ladies and gentlemen, if I have not exhausted my subject I certainly have exhausted your patience. I will weary you no more.

Eighty years ago science gave us enlarged means of turning night into day; since then not a little of our lifetime has been spent in gas-lit rooms, and it has been somewhat of a reproach to science that she has not provided us with this larger measure of light without at the same time imposing on us the necessity of breathing a vitiated atmosphere.

To-day science vindicates herself; henceforth we may make the long nights of our northern winter bright without any such sacrifice.

## DEPREZ'S CURRENT MEASURER.

ALL mechanical actions exerted by currents on magnets, or by currents on currents, may be utilized in the construction of galvanometers. The first class of apparatus (currents acting on magnets) gives indications which are proportional to the intensity of the current, and the second (action of the current on itself) gives indications which are proportional to the square of intensity, on condition that the fixed and movable pieces remain always in the same relative position, and that the action of the current on the magnet exercises only a slight influence on the magnetic power of the latter. These two conditions are fulfilled in an apparatus invented a couple of years since by M. Marcel Deprez, and which is represented in the annexed cut. It has, as will be seen, a very great resemblance to the galvanometer described by M. Hospitalier. It consists of a horseshoe magnet, between the arms of which there is a galvanometric helix, occupying nearly the whole length of the magnet, and movable in knives, whose sharp edge is continuous with the axis of the magnet. The current is led into this helix by two small pieces of metal, which dip into a mercury trough, divided into two compartments in such a way as to in nowise interfere with the mobility of the helix. Finally, to the latter is attached a lever arm, along which slides a weight designed for balancing the mechanical couple resulting from the mutual actions of the current and magnet. When the helix is not traversed by any current the sliding weight occupies on the lever arm a position which is the zero of its graduation, and the intensity of any current whatever is accurately proportional to the distance at which it is necessary to place the weight from the zero mark in order to bring the lever into a horizontal position in spite of the current's action. It is easy to perceive that the two conditions above mentioned are satisfied in this apparatus, to the construction of which M. Deprez was mutually led, when, more than two years ago, he invented the electric motor (described and figured in a preceding number of this journal), in which he has utilized the magnetic power of all the points of a permanent magnet, instead, as every one had done before him, of confining himself to a utilization of the poles. The sole difference between the constituent parts of the motor and galvanometer consists in the suppression of the soft-iron core of the bobbin of the motor. This core, in fact, considerably increases the mechanical action of the current, but it has the inconvenience that it reacts on the magnet and destroys the proportionateness between intensities and the mechanical forces which measure them. It was, however, after suppressing the iron core of one of his motors, that M. Deprez devised the instrument under consideration, which still bears the vestiges of its original purpose.

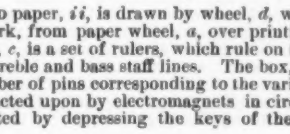


CURRENT MEASURER.

## PRINTING MUSIC BY ELECTRICITY.

By H. Y. DICKINSON, Newbury, Berkshire, England.

PREPARED paper, *i i*, is drawn by wheel, *d*, which rotates by clockwork, from paper wheel, *a*, over printing table, *b*. Within box, *c*, is a set of rulers, which rule on the paper as it runs the treble and bass staff lines. The box, *c*, also contains a number of pins corresponding to the various musical notes, and acted upon by electromagnets in circuits, which are completed by depressing the keys of the instrument played upon. Upon depressing any given key, the movable pin working in connection with this key is also depressed and marks a fine line on the paper, the length of the line corresponding to the time the note is held down. The pins are also so placed, that if a note would fall inconveniently high or low, the note will be printed an octave lower or higher, as the case may be, and the proper octave indicated by a mark produced in a similar manner.




## FAST SPEED WORKING ON CABLES

PERHAPS at the present time no field of invention offers to electricians so rich a prize as that of submarine telegraphy. It is well known that the duration of a cable in good working condition is comparatively brief. It follows, therefore, as a matter of necessity that the profit on the large capital outlay, entailed in laying a cable, and the requisite reserve fund, must be secured during a period varying from ten to possibly twenty years. Now the carrying power of a submarine line being limited (although, thanks to the ingenuity of Mr. Stearns and the Messrs. Muirhead, less so than formerly), it follows that while the above conditions last, the tariffs must remain quite up to the existing rates if they are to be at all profitable.

It is, however, a matter well worth consideration whether the carrying power of cables cannot be increased by the employment of a quadruplex or multiplex system, or by the employment of automatic fast speed apparatus. The latter seems the more likely field for successful invention, and although we believe something has been attempted in this direction, no success has been attained as yet. The idea of the new American Cable Company recently organized in New York, to submerge a translator or repeater in mid ocean, is undoubtedly a correct one, but the practical feasibility of the project is more than open to question. It is hardly too much to say that no piece of mechanism has ever yet been devised which can be trusted to work with certainty to an indefinite period without human supervision. As is well known, the cause of the retardation of signals in submarine cables is the inductive effect, which causes the cable to hold a charge which has to be got rid of after each signal has been sent and before another can be transmitted. Could some arrangement be devised by which this charge can be "wiped out" at *both* ends of the cable simultaneously, a great advance would be made toward solving the problem of fast speed submarine telegraphy. It seems to us that there is considerable scope for invention in this direction.

All inventions for working through long ocean cables must necessarily be unsatisfactory unless submitted to actual test; but the latter to the very great majority of inventors is an impossibility, as they cannot have access to any cable on which to make their experiments. Seeing the importance of the subject, we would suggest that among the apparatus provided for the proposed public electrical laboratory in connection with the Society of Telegraph Engineers, an artificial cable might with great advantage be included.

One thing is at least certain—that the fortunate inventor who can effect a notable improvement in the direction of fast submarine telegraphy will be in the enviable position of being able practically to demand his own terms. Take, for instance, the case of a company with a given number of cables, the traffic continuous, and the tariff adjusted so as to be sufficiently profitable. Continue the supposition, and imagine another company laying a single line of a precisely similar type of cable, but the carrying power of which was by any means considerably increased. The traffic over this cable could be conducted at a proportionately less rate than over any one of the others, with as good, perhaps a better, remuneration than it could be by the company owning the larger number of cables, but which worked at the slower speed.

The inventor who can materially increase the rate of working on submarine lines will be able, as we before stated, to demand his own reward; the then existing companies must either buy or run the risk of what would be an overwhelming competition. The field is open to all; a fortune will probably be the reward of him who tries to solve the problem, and—succeeds.—*Telegraphic Journal.*

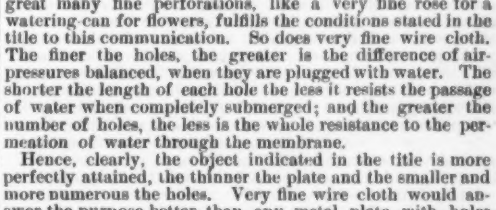
## ON A SEPTUM PERMEABLE TO WATER, AND IMPERMEABLE TO AIR, WITH APPLICATION TO A NAVIGATIONAL DEPTH GAUGE.*

A SMALL quantity of water in a capillary tube, with both ends in air acts as a perfectly air-tight plug against difference of pressure of air at its two ends, equal to the hydrostatic pressure corresponding to the height at which water stands in the same capillary tube when it is held upright, with one end under water and the other in air. And if the same capillary tube be held completely under water, it is perfectly permeable to the water, opposing no resistance except that due to viscidity, and permitting a current of water to flow through it with any difference of pressure at its two ends, however small. In passing it may be remarked that the same capillary tube is, when not plugged by liquid, perfectly permeable to air.

A plate of glass, or other solid, capable of being perfectly wet by water, with a hole bored through it, acts similarly in letting air pass freely through it when there is no water in the hole; and letting water pass freely through it when it is held under water; and resisting a difference of air-pressures at the two sides of it when the hole is plugged by water. The difference of air-pressures on the two sides which it resists is equal to the hydrostatic pressure corresponding to the rise of water in a capillary tube of the same diameter as the narrowest part of the hole. Thus a metal plate with a great many fine perforations, like a very fine rose for a watering-can for flowers, fulfills the conditions stated in the title to this communication. So does very fine wire cloth. The finer the holes, the greater is the difference of air-pressures balanced, when they are plugged with water. The shorter the length of each hole the less it resists the passage of water when completely submerged; and the greater the number of holes, the less is the whole resistance to the permeation of water through the membrane.

Hence, clearly, the object indicated in the title is more perfectly attained, the thinner the plate and the smaller and more numerous the holes. Very fine wire cloth would answer the purpose better than any metal plate with holes drilled through it; and very fine closely-woven cotton cloth, or cambric, answers better than the finest wire cloth. The impenetrability of wet cloth to air is well known to laundresses, and to every naturalist who has ever chanced to watch their operations. The quality of dry cloth to let air through with considerable freedom, and wet cloth to resist it, is well known to sailors, wet sails being sensibly more effective than dry sails (and particularly so in the case of old sails, and of sails of thin and light material).

An illustration was shown to the meeting by taking an



Water indicated by horizontal shading; Air by white paper.

Argand lamp-funnel, with a piece of very fine closely-woven cotton cloth tied over one end of it. When the cloth was dry, and the other end dipped under water, the water rose with perfect freedom inside, showing exceedingly little resistance to the passage of air through the dry cloth. When it was inverted, and the end guarded by the cloth was held under water, the water rose with very great freedom, showing exceedingly little resistance to the permeation of water through the cloth. The cloth being now wet, and the glass once more held with its other end under water, the cloth now seemed perfectly air-tight, even when pressed with air-pressure corresponding to nine inches of water, by forcing down the funnel, which was about nine inches long, till the upper end was nearly submerged. When it was wholly submerged, so that there was air on one side and water on the other, the resistance to permeation of air was

* Paper read at the British Association by Sir William Thomson.

as decided as it was when the cloth, very perfectly wet, had air on each side of it.

Once more, putting the cloth end under water, holding the tube nearly horizontal, and blowing by the mouth applied to the other end, the water which had risen into the funnel before the mouth was applied was expelled. After that no air escaped until the air-pressure within exceeded the water pressure on the outside of the cloth by the equivalent of a little more than nine inches of water; and when blown with a pressure just a very little more than that which sufficed to produce a bubble from any part of the cloth, bubbles escaped in a copious torrent from the whole area of the cloth.

The accompanying sketch represents the application to the navigational depth gauge. The wider of the two communicating tubes, shown uppermost in the sketch, has its open mouth guarded by very fine cotton cloth tied across it. The tube shown lower in the diagram is closed for the time of use by a stopper at its lower end. A certain quantity of water (which had been forced into it during the descent of the gauge to the bottom of the sea) is retained in it while the gauge is being towed up to the surface in some such oblique position as that shown in the sketch. While this is being done the water in the wide tube is expelled by the expanding air. The object of the cloth guard is to secure that this water is expelled to the last drop before any air escapes; and that afterward, while the gauge is being towed wildly along the surface from wave to wave by a steamer running at fourteen or sixteen knots, not a drop of water shall re-enter the instrument.

## A NEW PROCESS FOR THE METALLURGIC TREATMENT OF COMPLEX ORES CONTAINING ZINC.*

By EDWARD A. PARNELL, F.C.S.

THE subject to which I have the gratification of inviting your attention, namely, the effective and remunerative treatment of certain complex ores containing zinc, has been an important problem in metallurgy. It is well known that the presence of zinc in considerable quantity in ores containing other metals has a very injurious influence in the ordinary smelting processes for the extraction of the latter. In the case of copper ores, for example, the presence of much zinc necessitates additional operations in order to obtain copper of good quality; and all the zinc originally present in the ore is lost. Of still greater inconvenience is the presence of much zinc in lead ores, when the ordinary smelting processes are pursued; not only are the operations impeded thereby, but there is also a considerable loss of lead. Hence it follows that copper ores containing much zinc are rejected by the copper smelter, and lead ores containing much zinc are rejected by the lead smelter.

Further, ores of this complex character are not adapted to the use of the zinc or spelter manufacturer. From the peculiar character of his reduction process, in which the cost of earthen retorts forms a considerable item in his working charges, it is essential that his raw material contain a considerable proportion of zinc: less than 25 per cent. would be regarded as unsuitable. Not only so, but the presence of certain other metals, especially lead, is highly objectionable to the spelter maker from their injurious action on the earthen retorts. Zinc ore containing 8 per cent. of lead would be discarded.

Hence the necessity of resorting to some means of separation before having recourse to the ordinary smelting processes. Of course the mechanical method of "dressing" is always adopted wherever it is practicable. In ordinary mixed ores containing galena and blende, this is easily accomplished by the great difference between the specific gravities of these two minerals; but in many cases separation by dressing is impracticable. Thus blende and copper pyrites resemble each other in density too closely to allow of separation by dressing. Again, blende and galena are often found so intimately mixed or combined (forming apparently a homogeneous mineral) that their separation by dressing is too difficult to be practiced on the large scale; in fact, this is in some cases quite impossible. The plumbiferous blende found in Anglesea, commonly known as "bluestone," is of this character. Enormous quantities of copper ores also exist, the raising of which would be very profitable were it not for the contaminating influence of 20 per cent. and upwards of zinc; but hitherto the highest prices paid for such by the smelter have been unremunerative to the miner. The cupriferous blende found in great quantities at Ain Barbar, in Algeria, is of this kind.

The extraction of zinc from such ores in a useful form has often been attempted by means of hydrochloric acid, after calcination of the ore, with the view of decomposing the chloride of zinc by lime. Serious impediments, however, to this method have prevented it from being adopted, especially the difficulty of washing the oxide of zinc from the chloride of calcium and obtaining it in a dense form, suitable for the spelter manufacturer; also, the injurious influence of the presence of chlorine in any form in the subsequent smelting of the residue containing lead and silver.

The separation of oxide of zinc from the calcined ore can of course be easily effected by sulphuric acid, but the great objection to this method has been the difficulty (hitherto generally considered insuperable on the large scale) of obtaining oxide of zinc from the sulphate, in a form suitable for the spelter manufacturer. In the process to which I would now invite your attention this difficulty is completely overcome.

When heated alone, sulphate of zinc requires a very high temperature to effect its decomposition. Such a method is impracticable on the large scale; but when mixed with a small proportion of a deoxidizing agent, sufficient to take one equivalent of oxygen from the sulphate, it is easily decomposed with the production of oxide of zinc and sulphurous acid. A mixture of 2 equivs. of zinc sulphate with 1 equiv. of carbon, heated to dull redness, affords oxide of zinc. With a larger proportion of carbon, sulphide of zinc is produced. Sulphide of zinc, whether artificial or native, is also well adapted for decomposing the sulphate. 3 equivs. of sulphate and 1 equiv. of sulphide produce 4 equivs. of oxide and 4 equivs. of sulphurous acid ($3ZnSO_4+ZnS=4ZnO+4SO_2$). Native sulphide of zinc is the reducing agent, which I prefer on the large scale for making oxide of zinc suitable for the zinc manufacturer.

I will now briefly describe the routine of operations at present pursued at the works of the Swansea Zinc Ore Company, which have been erected for carrying out the process on an extensive scale.

The principal ores operated on are the following, neither of which is "dressable."

* A paper read before the Chemical Section of the British Association, Swansea Meeting, 1880.

1. Complex ore from Cavalo (Algeria), containing, as sulphides—Zinc, 17 per cent.; lead, 16 per cent.; silver, 20 ounces per ton.

2. Cupriferous blende from Ain Barbar (Algeria), containing—Zinc, 23 per cent.; copper, 6 per cent.; silver, 6 ounces per ton.

3. Complex ore from Italy, containing—Zinc, 20 per cent.; lead, 12 per cent.; copper, 5 per cent.; also silver.

4. "Bluestone" from Anglesea, containing—Zinc, 28 per cent.; lead, 12 per cent.; silver, 12 ounces per ton; also gold and copper.

5. Ore from Constantine (Algeria) containing—Zinc, 12 per cent.; lead, 5 per cent.; copper, 1·5 per cent.; silver, 12 ounces per ton; also gold.

After having been ground sufficiently to pass through a sieve of six or eight holes to the linear inch, the ore is calcined with exposure to air, at a moderate heat. This calcination is effected in large muffle furnaces, the gas from which, when containing a sufficient proportion of sulphurous acid for making sulphuric acid, is conveyed to leaden chambers for that purpose. The sulphides of the various metals are thus converted into oxides and sulphates. A dull red heat is found by experience most favorable to the formation of sulphate of zinc; but it must be sufficient for the decomposition of ferrous and ferric sulphates. The calcined ore is next mixed with weak sulphuric acid in a revolving pan lined with lead (invented by Mr. J. W. Chenall); neutral liquors are first run off; afterwards excess of acid is introduced, and the acid liquors thus obtained, together with subsequent washings by water, are used for producing neutral liquors from a fresh charge of calcined ore.

The solution of sulphate of zinc thus obtained of course contains copper when that metal was present in the ore. Of iron it contains very little, provided the ore had been properly calcined, so as to peroxidize all that metal, the sulphuric acid combining by perference with oxide of zinc. I may mention, in passing, that a solution of ferric sulphate is decomposed when warmed with oxide of zinc, with precipitation of ferric oxide and production of sulphate of zinc.

From the clear neutral liquor copper is next precipitated in the usual way, either as metallic copper by means of iron or zinc, or as sulphide. The solution of sulphate of zinc is then concentrated by evaporation, and mixed when it begins to thicken with finely ground blende, in the proportion of one equivalent to three equivalents of zinc sulphate. This mixture, after being further dried, is lastly heated to redness in a muffle furnace. The mutual reaction which I have already described takes place with production of oxide of zinc and sulphurous acid. The latter, having no admixture of gases derived from the fire, is conveyed to leaden chambers for the reproduction of sulphuric acid.

The oxide of zinc thus obtained is in a condition well suited for the manufacture of metallic zinc in the ordinary way. Its strength and purity of course depend to some extent on that of the blende used as the reducing agent. When the latter contains about 45 per cent. of zinc, the oxide as withdrawn from the furnaces contains about 62 per cent. of zinc. It contains no impurity which is of any inconvenience in its application for making metallic zinc. The principal impurity is oxide of iron, derived partly from the blende added in the process, and partly from the use of iron as a precipitant for the copper. The impurity which the zinc manufactuer regards as most deleterious—namely, lead—is reduced to a minimum, being only the small proportion contained in the added blende. The same may be said respecting calcium.

Occasionally the oxide of zinc contains a little magnesium, owing to the presence of magnesian minerals in the raw ore. But this metal is not present in the oxide in the objectionable form of sulphate, but in the innocuous form of oxide. It may be interesting for me to remark here that sulphate of magnesia is easily decomposed by blende and other reducing agents in a manner corresponding to sulphate of zinc. When a mixture of single equivalents of sulphate of magnesia and carbon is moderately heated, magnesia is obtained mixed with very little undecomposed sulphate. Magnesia thus prepared corresponds in density to what is known as "heavy" calcined magnesia. It will be obvious that this method of preparing that article will be found far more ready and economical than the common method of precipitation as carbonate and calcination.

I have now to revert to the portion of the ore left undissolved after treatment with dilute sulphuric acid. This of course, contains all the lead originally present in the ore. The same may be said of the gold and silver. It might be expected that a portion of the silver would be sulphated and rendered soluble during the calcination of the ore. This is doubtless the case to a small extent, but I have always found that the minute quantity of silver thus rendered soluble is less than corresponds to the trace of chlorine present in chamber sulphuric acid, and chloride of silver is quite insoluble in solution of sulphate of zinc.

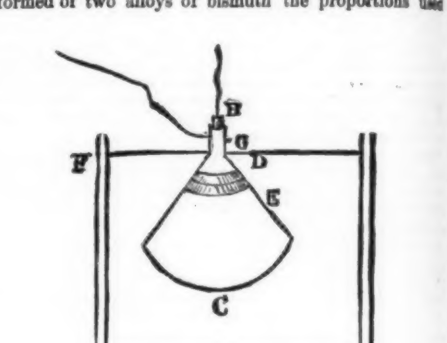
For the further treatment of this residue the ordinary well-known smelting processes are resorted to, the products being argentiferous and auriferous lead, and also copper regulus, which generally contains both gold and silver. At the works of the Swansea Zinc Ore Company, the smelting of the residue is effected in cupolas; an important appendage to which is the lead fume condenser patented by Messrs. Wilson and French, of Sheffield (brought before the notice of the British Association last year), in which the gases from the furnace are forced under water and allowed to pass up through layers of fine copper gauze. I am happy to be able to state that this condenser is now being worked very satisfactorily.

In conclusion I would remark, as will doubtless have occurred to you, that this mode of treating sulphate of zinc is capable of other applications besides the complex ores I have referred to. Such, for example, as the residue of blende after the richer portion has been separated. Immense quantities of such residue exist containing 22 per cent. of zinc, the further dressing of which is not profitable. This is of no value in its present condition, but capable or profitable application by the process I have described. It may also be applied to lead fume containing zinc, and to the crude sulphide of zinc derived from burnt iron pyrites containing blende, of which a large quantity is used in Germany for making sulphuric acid.

In reply to inquiries respecting the density of the oxide of zinc thus prepared (a matter of great importance to the spelter manufacturer), Mr. Parnell stated that it is rather greater than that of ordinary calcined calamine. The oxide is in every respect admirably suited to the manufacture of zinc.

## ELECTRO-CHEMICAL ANALYSIS OF METALS.

THE convenience of the port of Swansea, Wales, together with the extensive anthracite mines in the neighborhood, has made the town the principal seat of the copper trade of Great Britain; in fact, it has been estimated that nine-tenths of the copper used in England is from Swansea and its environs. Enormous quantities of copper ore are brought hither for smelting from Cuba, North and South America, Australia, Spain, Algeria, etc. With the manufacture of copper is also associated that of other metals, precious or rare, such as tin, silver, nickel, and cobalt. The ores as they arrive are placed in piles under sheds on the wharves, and, before being sold, are analyzed on the spot by the consignees. In analyzing the ores, some of the larger houses have adopted an electro-chemical process which is remarkable for its power, rapidity, and simplicity. It has been in use for about a year, and bids fair to entirely replace the old processes by dry way. The copper ore is dissolved in nitric acid, and the solution, properly neutralized, is submitted to the action of a thermo electric pile, heated by a gas flame. The constancy of this pile is tested by means of a voltameter, which, in construction, is something like that of Mr. Warren de la Rue, and in which is decomposed a definite number of cubic centimeters of gas per minute. When the electro-chemical decomposition does not give the requisite number of cubic centimeters the pile is changed. The pile is formed of two alloys of bismuth the proportions used




ELECTRO-CHEMICAL ANALYSIS OF METALS.

being unknown, since the alloys are manufactured in Germany by a French electrician, who withholds his secret. It might, however, it should be understood, be replaced by any pile which is sufficiently constant. The essential part of the process, outside of the art of making the solutions, lies in the form given to the poles and in the manner of using them. The negative pole, C (see cut), in which the copper is deposited, is shaped like an inverted funnel, and into its interior passes a platinum wire inclosed in a glass tube, B, designed to prevent contact. The deposit of copper takes place on the internal as well as the external surface of the funnel. When the pile is sufficiently weak and constant the deposit formed is very adherent and possesses a magnificent metallic aspect, and may be dried and assayed without any sort of difficulty. The operation usually takes from six to seven hours, and, when finished, there is nothing to do but weigh the platinum cone carefully, and thus determine the weight of the copper deposited. To ascertain whether any copper still remains in the liquid, the funnel is again immersed therein, when, whatever metal is present, will form a thin film at the upper part of the cone. If no deposit forms, it is a sure proof that no copper remains, and the operation is, therefore, practically finished. This same process may serve for the analysis of any metal whatever, provided the other metals present be precipitated, and that no solutions containing chlorine be used, since this element would form a certain amount of platinum chloride, which would injure the pole and vitiate preceding determinations.

## LEAD—HOW TO COAT ARTICLES THEREWITH—THE GALENIZING PROCESS.

PROFESSOR EMERSON REYNOLDS thus describes one of the best methods of applying his new process of galenizing, or covering with lead various substances: Take 16 grammes of solid sodic hydrate (NaOH) or an equivalent of other suitable hydrate, dissolve it in 1·75 liters of water, and add to the liquid 17 grammes of lead nitrate ($Pb2NO_3$), or an equivalent of other lead salt, with 250 cubic centimeters of water; raise the temperature of the mixture to 90° C. If sufficient lead salt has been added the liquid will remain somewhat turbid after heating, and must then be rapidly strained or filtered through asbestos, glass-wool, or other suitable material, into a convenient vessel. The filtered liquid is then well mixed with 100 cubic centimeters of hot water containing in solution 4 grammes of sulpho-urea or thio-carbamide. If the temperature of the mixture be maintained at about 70° C., deposition of galena in the form of a fine adherent film or layer quickly takes place on any object immersed in or covered with the liquid, provided the object be in a perfectly clean condition and suitable for the purpose. When the operation is properly conducted a layer of galena is obtained, which is so strongly adherent that it can be easily polished by means of the usual leather polisher. It is not necessary to deposit the galena from hot liquids, but the deposition is more rapid than from cold solutions.

The most convenient solution for deposition on brass is thus prepared: Take a quantity of soda lye containing 1½ ounces of real soda (NaOH); dissolve in this, with the aid of heat, 3 ounces of tartate of lead, and just before diluting the solution to one gallon of cold water, add 5 drachms of sulpho-urea previously dissolved in a small quantity of hot water. The articles are to be immediately immersed in this bath, and the temperature raised to boiling. When the desired tint is obtained the articles are to be removed, washed, and polished. The above solution can be used for glass or porcelain, hot or cold, if the proportion of alkali be reduced one-third or thereabouts.

## SOAP IN POMADES.

THIS is a decided improvement. Before the perfume an ounce of soap, dissolved with 2½ grains of borax in hot water, should be added to 3 lb. of the pomade. This makes the pomade snow white and very unctuous. Another advantage is that a third of its weight of water can be incorporated with it.—*Zeitschr. d. österr. A. V.*

## SYNTHESIS OF ALCOHOL.

ALCOHOL is easily oxidized into acetic acid, as the brewer knows to his cost, but the converse change has hitherto been unknown. The conversion of acetic acid into alcohol has been accomplished by M. Lapeyière, who contributes the following account of his experiments to *La Nature:*

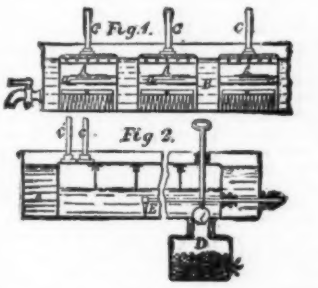
"In the porous vessel of a small size Bunsen cell, I replaced the nitric acid by a concentrated solution of very pure crystallizable acetic acid; the external compartment containing very dilute sulphuric acid. I then short-circuited the cell, and left it in action during a certain period (from April 29 to May 27). At the end of this period the acetic acid had disappeared from the porous cell, being replaced by alcohol in sufficient quantity to allow of my obtaining a few grammes of this substance by distillation. As I had foreseen, the acetic acid assimilated the hydrogen necessary for the production of alcohol. I found by a further experiment that the acetic acid was first converted into aldehyde, and afterwards, by a further absorption of hydrogen, into alcohol, the successive changes being expressed by the following equations, in the equivalent notation:

1. $C_4H_4O_4+2H=C_4H_4O_2+2HO$;
2. $C_4H_4O_2+2H=C_4H_6O_2$.

## MANUFACTURE OF SODA.

By C. A. DE LA MARTELLIÈRE, Paris.

IN the manufacture of soda by the ammonia process the hydrochlorate of ammonia liquors are usually mixed with lime and distilled, so as to eliminate the ammonia, which is converted into bicarbonate by a current of carbonic anhydride produced by calcination of limestone. This invention relates to a process and apparatus for treating the liquors above mentioned to obtain from them the bicarbonate in a simple manner. For this purpose the hydrochlorate of ammonia liquors are heated for some time in a boiler to drive off the free bicarbonate which is collected. The liquors are then evaporated until the sal ammoniac is precipitated in vessels described in Specification 4353 of 1878. The precipitated sal ammoniac is drained and made into a paste with powdered carbonate of lime or dolomite, and




the mixture is slowly heated in retorts. Toward the end of this operation a little milk of lime is introduced into the retorts to decompose the last traces of sal ammoniac. The fumes are condensed in the special apparatus shown in the illustrations. A number of shallow vessels, A A, are immersed in a tank, B, through which cold water circulates. In the vessels, A A, are a number of partitions, *a a*, extending about half way down, so that their lower edges being immersed in the liquid, the fumes and gas introduced from the retorts into the first compartment by the pipes, C C¹, are caused to bubble from compartment to compartment and to become absorbed. Near the end is the receptacle, D, into which the solid precipitate is raked by the rake, E, for removal.

## FLAYING OF THE VOCAL CORDS.

By Dr. CARLO LABUS, of Milan, Lecturer on Laryngoscopy in the Royal University of Pavia. Translated by Charles E. Sajous, M.D.

IN a pamphlet of twenty-four pages, Dr. Labus introduces a novel operation for the more rapid and permanent cure of chronic congestion of the vocal cords. The first pages of the monograph are devoted to the causes giving rise to the affection in question. After describing in a very clear manner the operation, the author gives a list of twelve cases (among whom are some prominent singers), showing results of a very satisfactory character.

The length of the paper not allowing its publication in full, the following extract will serve to show its principal points:

Considering the facility with which traumatic endolaryngeal lesions are cured, frequently without even leaving the least trace of the trouble (as I was able to convince myself in sixty cases of laryngeal tumors extirpated laryngoscopically), and guided by the criterion of analogy, that when loss of substance occurs in the superficial strata of mucous membrane repair takes place completely, the idea occurred to me to attempt the removal of that part of the membrane which had become hyperplastic, and wait for the formation of a new tissue, identical with the normal, and possessing all the qualities requisite for perfect phonation. To obtain this result it became necessary to create a traumatic lesion, avoiding unnecessary laceration, thereby diminishing the chances for excessive reaction, which would compromise an otherwise normal and rapid cicatrization. I thought to effect this by stripping the cord of the hyperplastic tissue covering it, using for that purpose an instrument such as Tuerck's polyp-crusher, or a toothed forceps of some kind, with lower branches turned before or backward.

To succeed in performing so minute an operation, it is necessary that the patient acquire perfect toleration of the instrument, to obtain which I resort to repeated manipulation. This having been obtained, Türck Schrotter's method of anæsthesia may be used for the operation, but I am not disposed to advise it, the inflammatory reaction secondary to the application of chloroform retarding the recovery.

The operation is performed during inspiration; the cords being then separated, the hyperplastic mucous tissue presents itself so that it can easily be seized. If the inflammatory process extends over more tissue than the instrument can embrace, it becomes necessary to strip the whole affected extent. The operation is said to give but little pain. For the moment the voice becomes clearer, but very soon it becomes weaker and weaker, until complete aphonia exists, which lasts two or three days; this is caused by paralysis of the superior fasciculus of the thyro-arytenoid muscle. The consecutive reaction is but very slight; the cords present slight redness and turgescence, the flayed space remaining perfectly white. As a general thing the lesion becomes cicatrized in three or four days, and nothing remains but a slight turgescence, which gradually disappears. The voice returns with all its delicacy and purity.

The consecutive treatment can be said to be negative. Pain, a slight burning sensation lasting a few hours, requires but little attention. Abstinence from irritating drink, smoking, and from breathing a vitiated atmosphere, or exposure to causes giving rise to coryza or bronchial catarrh, is necessary; but, above all, silence must be observed the first few days, in order to give the organ complete rest. Local medication, producing irritation, retards recovery. If, however, the reduction of the turgescence should be too slow, then only very weak astringent inhalations may be advised. The material condition of the cord operated upon does not allow the least exercise at singing for at least one month after the cure of the lesion, to secure complete absorption of the exudation and coaptation of tissues.

The idea of resorting to the above process came to me seven years ago, while having under treatment a celebrated singer. The mucous membrane of the middle third of the right vocal cord was raised, so to say, detached, rendering the voice impure, and strongly compromising a brilliant career. A local astringent treatment relieved her enough to allow her to return to the stage, but the improvement was but momentary. Impressed by this, I decided to attempt denuding the cord of its hyperplastic tissue in cases of like nature, and very soon an opportunity presented itself in the person of M. Roussel, a tenor. This artist, after a career of eight years, found himself forced to abandon singing, his voice having become defective. After a cold contracted some time before, his voice had remained impure. On the margin of the right vocal cord and on its anterior third the mucous membrane was somewhat relaxed and projecting, and during phonation vibrated with the cord. Having tried, without result, insufflations of astringent powders, I proposed the extirpation of the loose portion of the membrane, which was accepted as a last resort, a year's continuous treatment having proven ineffectual. After four days' manipulation I was able to touch the cord without exciting reflex action. On September 22, 1874, I prepared myself for the operation, and so as to obtain the highest tolerance possible, I resorted to local anæsthesia. Following the proceedings described above, the operation was performed without difficulty; the reaction was almost nil; the voice weakened for a day or so, but on the third had returned, and continued clearing so rapidly that in a week he could be considered as cured, the larynx not presenting the least trace of the lesion, and the margin of the cord being perfectly straight and smooth. As to his voice, in filling an engagement the following December, it was characterized as "admirable," by the papers of the day, and compared to that of Rubini.

In February, 1875, Signora Rosa Bellincioni, contralto, came to me, complaining that during the past year the least prolonged singing caused great fatigue and lowering of the voice. The right vocal cord was somewhat tumid and pinkish in its anterior and middle third, and its margin projected in the rima glottidea at certain points. I prescribed a local astringent treatment, and did not see the patient until the following February. She then related that she had followed my treatment, without advantage; that her voice was worse notwithstanding, since the year before she could reach G fourth octave, and now she could only reach E flat fourth octave, and that in that state she could absolutely not sing. On examination I found the same tumefaction as the year previous, only increased, and of a bright red. The operation being proposed and accepted, twelve days' manipulation of the larynx enabled me to master the organ so as to be able to perform the operation without anæsthesia. The voice instantly became clearer. There was no reaction, not even lowering of the voice. In twenty days the cord was perfectly white, and its border smooth and straight; the voice was very clear, and she could reach F sharp fourth octave. One month later it had taken its normal extension.

In May, 1876, Signora Flora Mariani, mezzo-soprano, came to me suffering with catarrhal pharyngitis, and stating that since winter her voice did not respond to her requirements; that she could not attack and sing in high register, and that it had lost its clearness. She had overused her voice; had sung parts too high for it; and, worst of all, had sung while under the effects of a cold. Besides the pharyngitis, I found both vocal cords reddish and tumid. I advised her rest and the use of a local astringent treatment. One month later she again called, with full intention to undergo thorough treatment. I began with astringent insufflations, with notable advantage at first, the left vocal cord, in fact, returning to its normal condition. After twenty days' treatment, not noticing much progress, the right vocal cord retaining its tumid condition, and encouraged by the results obtained in the cases narrated above, I proposed my new operation; that is to say, to strip the cord of the hyperplastic tissue which did not show a tendency to reduction. After a week's manipulation, on the 9th of July I extirpated the whole portion of tumid mucous membrane at once. The reaction was nil. At the end of two weeks her voice in speaking was natural. I did not allow her to sing before a month after the operation, the cord not presenting then the least trace of the lesion. Her voice was, in fact, admirable, and her high notes were as clear as before her illness. After a month's exercise at singing, the voice, instead of improving, began to weaken and lose its clearness. On examining the larynx I found the cord operated upon perfectly normal, white, smooth, with straight edge, but the left vocal cord was tumid and red throughout its whole extent. No doubt, the exacerbation of the same inflammatory process I had found on her first visit existing in both cords, but which had been temporarily mastered in the left by astringent medication and rest, had reappeared on resuming singing, the cord operated upon having resisted the labor imposed upon it. Naturally, the enthusiasm engendered by the success of the first operation led her to accept a second one very readily. In a few days I was able to introduce my forceps and extirpate the mucous membrane covering the left cord throughout its whole extent, which was done in three different applications, the instrument being too small to embrace it over its whole length. The pieces of mucous membrane were submitted to the eminent histologist, Prof. Bizzozero, who recognized them as composed of epithelium, a thin layer of connective tissue underneath, pervaded with a few blood vessels. This time there was marked hoarseness, but in ten days the cord was in its normal condition. A month later the voice had resumed its facility in attacking pianissimos, while the "notes piquées" were true and clear. Very soon after she started for Venice, and filled an engagement with great satisfaction. I saw Signora Mariani a year later, and again this spring, and I was able to observe the perfectly normal condition of the organ laryngoscopically, while her voice was pure and metallic.

In autumn, 1876, came to the Ospidale Maggiore a chorus singer, Angela Allini, belonging to the Scala. Her voice, that of soprano, had become coarse, almost masculine, this having been brought on by overwork, especially while the organ was indisposed. A laryngoscopic examination revealed a fact which I had occasion to observe once before in a singing artist; besides the usual redness and thickening, there was on the superior layer a long white stria running longitudinally, and resembling an antheromatous patch. After six days' manipulation, I extirpated the superior mucous layer of both cords.

Forced by poverty to enter upon her duties sooner than I desired her to do so, the patient resumed her labors at the end of a week. She sang through the whole carnival, the result being merely a slight weakness in tone and a slight redness of the cords; but these were not in the least tumid.

In September, 1877, Dante Del Papa, a tenor, came to the hospital complaining of hoarseness. I found the right vocal cord congested and swollen. Not producing any relief with astringent applications, I performed the operation, with entire success. The reaction was very slight, the voice being hardly veiled at the end of three days. After a short period of rest the patient returned home, and shortly after I heard that he was filling an engagement with entire satisfaction.

The following are the conclusions which I believe to be able to advance:

1st. Catarrhal inflammation of the larynx is frequent among singers.

2d. Said inflammation has for its cause, besides rheumatic diathesis, the abuse of the functions of the larynx, and its use in pathological condition.

3d. It easily passes to chronicity, localizing on the vocal cords, these bearing the brunt of the functions of the organ and resulting in hyperplasia of the epithelial stratum and of the adjoining mucous layer.

4th. The result of this inspissation of the mucous membrane which invests the cords is an alteration in the voice, very often only noticeable during singing, but sufficient to impede the artist in exercising his profession.

5th. The treatment by topical applications is long, seldom giving rise to complete cure; oftener produces but a short amelioration, and in most cases fails completely.

6th. The process of flaying is not only innocuous, but gives more complete and lasting results, and that in shorter time, constituting the true radical treatment of hyperplastic inflammation of the vocal cords.

## COLD AS A CAUSE OF DEAFNESS.

DR. THEODORE GRIFFIN of La Prairie, Ill., says, in a communication on the above subject to the St. Louis *Medical and Surgical Journal*, October 5, 1880:

It being a fact that serious results do follow the action of cold, we are led to inquire, first, how can the injurious effects of cold upon the ears be prevented? And secondly, how can they be cured after they have been developed?

The first inquiry can only be answered by giving directions as to suitable coverings for the mouth and ears in inclement weather. Those whose ears are sensitive to atmospheric changes should not expose them to currents of cold air. When in the street some covering should be worn, not only over the ears, but over the mouth and nose if the weather is severe. Strict attention to the above directions would save many from much suffering.

*The mouth and nose are not sufficiently guarded as gateways to the ears.* A majority of the diseases of the ear find their way to that organ by their openings. Cold passes through the mouth and nose and on through the Eustachian tube into the cavity of the middle ear. Too little prominence is given to this fact; every act of swallowing sends a current of air plump into the cavity of the middle ear. After being out in the cold for some time, the air in the mouth and nostrils becomes cold, and it is frequently quite irritating to the sensitive structures of the middle ear.

A woolen covering of some kind worn over the mouth and nose would warm the inspired air and diminish to a great degree this danger to the ear. As a protection to the external ear I would advise any warm covering, but for obvious reasons would warn you against the use of a plug of cotton or any other plug in the external auditory canal, and let but little wrapping around the throat suffice; use the least quantity compatible with comfort.

The answer to the second query is not less important, but compliance with the intricacy of all the delicate details of treatment of many of the diseases of the ear fall most generally within the province of the specialist. To the physician whose armamentarium is made up with the view of combating these diseases, I would say, do not be discouraged by failures to cure, but be thorough in tracing out the pathological condition of every patient's ear which you may examine. Scrutinize every avenue of approach to the ear, particularly the pharynx, fauces, nasal cavities, and Eustachian tube; you must become familiar with the use of the Eustachian catheter, the rhinoscope, and all other now indispensable instruments for the diagnosis and treatment of aural diseases. Ear diseases are generally more or less amenable to treatment, though patience and perseverance are often required, both on the part of the physician and patient, for months of treatment are sometimes necessary to perfect a cure.

## WHAT DETERMINES THE SEX OF CHILDREN?

So many interests center in the discovery of the laws which determine the sex of children, that no apology is needed for bringing the more recent views on the subject to the attention of readers.

The latest studies exclude, or nearly exclude, any supposed information which could be derived from the study of sexual development in plants or the lower animals. In the former, it is principally a matter of nutrition, and to some extent so in the latter; while in man this is certainly not the case.

The first question is, *When* is sex determined? Is it at the time of conception or subsequently?

The answer to this appears to be given by the facts connected with double and triple births. It is in the human race a law, without exception, that *twins embraced in the same chorion are of the same sex.* Three explanations of this fact suggest themselves:

1. They are of the same sex because they are nourished by the same maternal blood; but this fails, because then

twins must always be of the same sex, which they are not.

2. They are of the same sex, because they are equally nourished from the same placental vessels; but this fails, because when one is amorphous, acephalous, or stunted, the sex remains the same.

3. That the sex was determined at the moment of conception; which is the only theory left. But what is true of twins, must be true of single births; therefore, we reach the decision that sex is fixed by the circumstances of conception. Such is the reasoning of Dr. Mayerhofer (*Von der Zeugung des Menschen*), and it seems conclusive.

The next question is, are the ovula or spermatozoa divided sexually, so that a given ovum, or spermatozoon can only produce one sex, or is it a matter which depends on the relative condition of the parents at the time of cohabitation?

The former theories have been often maintained. Prof. Schultze teaches that the ovula in the ovary are fitted, some to develop only male, others only female infants. The ancients thought that the secretion of the one testicle produced males, of the other females.

Both these and all similar theories cannot stand criticism. A very extensive and careful study of marriage, occurring over Germany, France, and England, conducted by independent statisticians, leads directly to the formulating of the following rule: *Whichever party to coition is at the time in the fullest possession of his or her reproductive powers will determine in the embryo his or her sex.*

The facts are, that quite young men marrying women older than themselves, and quite old men, marrying vigorous women, both beget more girls than boys. Husbands, as a rule, being older and more vigorous than their wives, as a rule more boys than girls are born (106 boys to 100 girls). When those marriages are taken in which the husbands are all older, but not more than ten years older than their wives, the proportion of children is about 700 boys to 600 girls.

There is hardly any doubt that the physical condition of the parent at the time of conception influences the sex in the direction that the most vigorous sex tends to perpetuate itself. It is part of this rule that when the male cohabits rarely, and thus has more vigorous and numerous spermatozoa, the children are more apt to be male. This is undoubtedly the case with lower mammalia, and may explain the fact that orthodox Jewish families have more boys than Christian ones, the male being restricted in the times of cohabitation by Leviticus, chapter xv., verses 19–28.

It is easy to misinterpret the facts in relation to this question. Quite recently, a writer in the London *Lancet* (Oct. 23, 1880), maintained that sex is determined by the *relative ardency* of the two parents; a preponderance of impulse on the part of the male parent produces female offspring, while excess on the part of the female parent produces male progeny. Among the facts he alleges in support of this opinion are the following:

(*a*) The first children of quickly married parents are generally females. This is particularly noteworthy in the case of men marrying with a strong feeling of personal affection, or an especial desire for heirs.

(*b*) Children born as the result of unions in which the female parent is not a consenting party, or is averse from the union, are almost invariably females.

(*c*) Female children commonly resemble their male parents in early life, and at the successive periods of change occurring in the course of development and decadence. On the other hand, the offspring of unions, or periods, in which the female parent is the more ardent are nearly always males.

(*a*) The first children of parents whose union has been long delayed are generally males; so also are those of unions in which the male parent is not specially attached to the female.

(*b*) The offspring of unions in which the desire of the male parent for an heir has become less ardent, while that of the female parent has increased, are generally males.

(*c*) Children born under circumstances in which the female parent is the more exigent are, with rare exceptions, males.

Now, as we above stated, when the male is temperate in indulgence, either from lack of affection, absence, or prudence, the spermatozoa are more vigorous and more apt to perpetuate the male sex; when the male exhausts the vigor of his secretion by repeated drains, the ovum gains the preponderance of power, and perpetuates its sex. We do not believe that a single one of the above facts proves that *ardency*, that the sexual passion, in other words, has *directly* anything to do with deciding the sex. It is a concomitant, not a cause. This mistake leads the writer in question to formulate a law almost the reverse of the one we are defending. His law is: "Granted a predominance of the procreative force on one side of the parentage, the offspring will be found of the *opposite* sex."

The simple fact he overlooks is that procreative force and sexual passion are not identicals, but almost opposites. Yet a little reflection will convince any one that violent sexual passion almost always excludes procreation. Obstetricians know that a common cause of sterility is very frequent cohabitation (Billroth, *Handbuch der Frauen Krankheiten*, Ab. vii., s. 60) Hence, it is not the preponderance of procreative force or the ardency of the one parent which leads to the children being opposite in sex, but it is the fact that the other parent, with less ardency, retains the force and expends the powers of the generative system, not in "a waste of passion," but in imprinting sex on the embryo.—*Med. and Surg. Reporter.*

## THE STORY OF A PLANT.

THE second lecture of the afternoon course of lectures to women was given Tuesday afternoon at the vestry of the Richmond street Church, by Miss Margaret Cheney, of Jamaica Plain.

Miss Cheney began the history of a plant, illustrating her subject by colored plates and drawings and by the blackboard. She showed how in all its stages, from the germination of seeds, plants are made useful or ornamental to man, and how they are related to the animal kingdom. The vegetable kingdom may be said to stand between the animal and the mineral. The plant has the power of taking mineral or inorganic matter and changing it into organic; that is, it feeds upon the mineral matter absorbed by its roots and pores. We cannot take the minerals we need directly, but must get them through vegetable or other animal life. Another service which plants render to animals is to purify the air of poisonous gases. The difference between a seed and a grain of sand is that the one has life, or is organized, and the other has not life, or is not organized.

Miss Cheney then described the incipient leaves in a bean. The principal substance found in most seeds which we use for food is starch. This is changed into sugar before the plant can use it. We seize upon this nourishment provided for the young plant and use it to nourish ourselves. The return we make to the plant is to protect it from weeds and other hindrances to its free growth; therefore it increases a thousand fold more than it would if we did not for our own purposes cherish it. When our young plant is started it has a root binding it to the soil, by which it finds water and mineral food; a stem to raise it into the light and air, with green leaves to help its work. The large fleshy roots, as beets and turnips, store nourishment that the plant will need next year. We could not live without the stems of plants, in the form of trees, which serve our necessities in many ways. Even the so-called mineral fuel is the remains of vegetables which grew millions of years ago. The tree stem is built up slowly, cell by cell, for perhaps hundreds of years. The leaves form a very important part of the plant, for in them is done all the changing the inorganic into the organic. The leaves are generally green, and contain a green granular substance called chlorophyl, which under the influence of sunlight does the work. Animals take into their lungs, in breathing, oxygen, which combines with the impurities of the blood, and forms carbonic acid, and is breathed out in that poisonous form. But this which is unfit for us to breathe over is taken into the plant by its millions of pores, and after the carbon is used in it, the oxygen is returned to the air. Thus the air is constantly purified by plants. The structure of leaves was then explained, and the group of organs called the flower. The fertilization of plants by pollen was made clear. We enjoy the gay and beautiful colors of flowers and think at first that its object is to give us pleasure. It has been pretty clearly proved that better seed results where the pollen reaches the ovule of another plant of the same kind than if it fertilizes the ovules of the same flower. My plants are therefore arranged to prevent self-fertilization, and to prevent cross fertilization. In this way insects are the most direct and important agents. The flower in most cases has honey which the insect wants. In seeking it, its wings and back are covered with pollen which fertilizes the next flower of the same sort entered. The bright colors serve to advertise the honey and induce the insect to bear, unconsciously, the pollen. The contrivances to insure this fertilization are wonderfully interesting.

People sometimes wonder that one who prizes a plant can tear it to pieces, but one who has never opened a plant and carefully examined it cannot know its marvelous beauty, and the order and harmony of nature. Each leaf has its own work to do, and each flower must grow as beautiful and perfect as possible in order to produce good seed, which will in turn produce another beautiful plant. We see also the dependence of one part upon another. An inefficient root prevents the leaves from receiving the water they must have. If the leaves shirk, no food is formed for the stem, and the flowers do not work; there are no seeds formed, and no reproduction.

Miss Cheney then gave instructions for the cultivation of flowers in houses, and told how to make a simple, cheap, but very good fern case, in which various wild plants, as well as ferns, will thrive. She also spoke of the insects which infest house plants, and how they may be kept in check. Geraniums, calla lilies, cyclamens, oxalis, ivies, and lobelia gracilis are among the plants which give a most satisfactory return for the labor expended upon them. What plants need, as truly as children, is care and petting. In reply to a question Miss Cheney gave an account of the drosera, or sun dew, which entices and devours insects.

It is pleasant to see a young lady like Miss Cheney mistress of her subject, and able to interest her hearers in what may be called its scientific aspects. Any gentlemen or children, who are interested in the topics presented at these lectures, would be admitted. There will be no others upon natural science, at present, but if the course is sustained, others may be expected.—*Providence Journal.*

## THE DESTRUCTION OF OUR FORESTS.

THAT the efforts of the *Lumberman* to awaken the people of the United States to a sense of the importance attaching to the question of the denudation of our forests have not been without avail, is evident from the attention which is being given to the subject in all parts of the country through the public press. The Chicago *Times*, a few days since, in its commercial columns gave some details of a conversation with Mr. E. W. Durant, of Stillwater, Minn., in which that gentleman is credited with the representation that the pine of Wisconsin had in the past been destroyed by fire to an extent greater than the volume of production under the woodman's ax, and that under the present rate of production the pine of that State would entirely disappear within twenty years. Mr. Durant is one of the best-informed lumbermen of the Northwest, and his opinion is entitled to great weight. We find, however, very few who believe that the present rate of production can be maintained in Wisconsin for anything like the length of time stated, and they are not few who maintain that in one-half that length of time the commercial importance of the forests of Wisconsin will have entirely disappeared.

A Mr. Thompson has recently contributed an article to the *Baptist Review* in which he treats of the question in the main from a correct standpoint, but grows reckless in his assertion on the strength of the statement of "a gentleman who has traveled over the territory, and says that, from Manitoba to the Gulf of St. Lawrence, there is not a sufficiency of all commercial woods in the Canadian provinces to supply the wants of the United States for three years." On the basis of the census of 1870, Michigan alone in pine could nearly answer this demand, and have 1,000,000,000 feet of hardwood, hemlock, elm, and spruce to spare after the contract was filled, and we are not prepared to believe that the entire timber supply in pine and hardwoods of our Canadian brethren in the vast territory named, is less than that of the one State of Michigan. The situation is bad enough without any undue expansion, but the commercial interests of the nation can best be subserved by truthful statements. It is easy for the editor of a country paper, sitting in his office and looking out upon a pond full of logs, to imagine that the region which has supplied them will always be available for even larger contributions; but those whose business it is to deal in timber lands, and who know the resources of each State, can be relied upon for a different statement. We suspect that the contributor to the *Baptist Review* is a man of little practical knowledge of the timber resources of the country, or he would know better than to give currency to so palpably erroneous statements as the one which he quotes.

As a theorist, however, we agree with him as to the growing necessity for the conservation of our forests through the intervention of the general government operating through a bureau of forestry. Even if the three years stated be extended to twenty years, which we believe to be an outside limit, in which the forests of the Northwest will yield in pine and hardwoods, including hemlock and elm, in anything like the quantities even now required by the commercial world, the period will at once be set down as bringing the end most dangerously near, and all wise and prudent men will recognize the necessity for such conservatism with regard to the subject as shall prolong the supply to the utmost extent.

A summing up of the views of the correspondent of the *Review* would be about as follows: "The four great timber States are Maine, Michigan, Wisconsin, and Minnesota. Of these, the first is now nearly stripped of her valuable timber, and the lumbermen are compelled to cut the young trees which should form the seed for a future growth. In Ohio, between the years 1853 and 1870, there were cleared over 4,200,000 acres—equal to one-sixth the entire area of the State, and equivalent to the removal of the timber from an entire county each year. Between 1870 and 1878 over 4,500,000 acres of timbered land had been cleared. The demand for white pine upon the northern sections of Michigan and Wisconsin has been so great that it is not believed that the supply can last longer than six or seven years. All the timber lands near the leading streams have long since been cleared.

The value of the annual cutting from the American forests is near $1,000,000,000, which is consumed in a thousand different ways. Over 100,000,000 cords are used for fuel. In 1871 10,000 acres were stripped to supply Chicago alone. To supply the demands of the railroads in the State of New York 50,000 acres of woodland have been cleared in a single year. Then the annual losses by forest fires are something enormous. The loss from the fires of 1871—which swept over Wisconsin, Michigan, and New York—is estimated at over $215,000,000. In 1876, and again in 1879, Pennsylvania suffered terribly from these forest fires, which in 1878 destroyed timber in value beyond computation in New Hampshire, Vermont, Massachusetts, Wisconsin, and New Jersey. In 1878 the woods on Lake Superior were afire almost continuously for 160 miles. These figures give a general idea of the importance of a proper care being taken of our forest lands and of the immense annual demand upon them.

There are two methods of remedying the evil—for it is an evil in more ways than one. The health of communities, the prosperity of large tracts of land, the fertility of the soil, even the supply of water and water-power, all these are largely dependent upon the actual conditions of our timber lands. The first method is a prevention of waste by proper restrictive measures, and the second is increased development and production by the maintenance of schools of forestry or arboriculture. What restrictive legislation is necessary or best we do not propose to discuss at present. Germany leads all nations in forest culture. Italy has a system of forest laws. Austria has adopted a system of forestry. The French forests are under the care of the ministry of finance. The cantons of Switzerland are planting trees. Great Britain has planted thousands of acres with oaks. Russia proposes to reforest various sections of barren country. Sweden has several laws regulating the cutting of timber. Even India has reserved and made inalienable large tracts of government forests. From the experience of these nations it will not be a difficult task to draw the lessons necessary to guide our legislative bodies in passing proper laws to adequately protect both the timber lands and their owners. As to the other plan of educating men in the science of forestry, we have an agency at hand which might be easily turned to our national advantage. Any system adopted to protect our forests—whether placing them under the charge of the interior department, or making them the objects of attention of a separate and independent bureau—would require agents to carry it into effect; and the better their knowledge of the subject the wiser their action and the more valuable the results of their labors. Hence the necessity and importance of establishing schools of forestry.

Now, most, if not all, the States have given large tracts of land to universities and educational institutions, nominally to enable them to develop agricultural departments. In some cases this object has been carried out. Cornell and other colleges have good departments for practical agricultural teaching; but in most of the colleges the revenue from these lands, if there is any, is carried to the general fund of the institution, and no pretense—or nothing more than a pretense—is made to teaching anything pertaining to agriculture. This is the case at Yale College, we believe, which has a large land-grant. These grants furnish the means to establish and maintain efficient schools of forestry. Nor could they be devoted to a better purpose. Such a school is not limited in its curriculum. It requires the services as teachers of entomologists, climatologists, geologists, botanists, and practical foresters. In Germany the course of study embraces chemistry, physics, meteorology, mineralogy, anatomy of plants, vegetable physiology and pathology, microscopy, zoology, geodesy, wood measuring, surveying, plan drawing, public economy and finance, cultivation of forests, forest improvements, forest history, civil law, criminal law, construction of roads, bridge building, and hunting.—*N. W. Lumberman.*

## SILKWORMS AND FOREST TREES.

AT the September meeting of the State Horticultural Society of California, Mrs. T. H. Hittel, of San Francisco, read a paper giving much information of timely value in view of the efforts making to naturalize silk culture in this country. As printed by the *Pacific Rural Press*, the paper runs as follows:

In a recent trip to Yosemite Valley I picked some specimens of the *Castenopsis chrysophylla* on Eagle Peak road, and brought them home with me. Having also taken a deep interest in silk culture, and learned something of the wild silkworm of China, and of the oaks upon which it feeds there, I began making such investigations as were in my power, and discovered, at least to my own entire satisfaction, that the chinquapin growing in our California mountains will feed the wild Chinese silkworm, and also that some of the other kinds of oak that grow upon the coast can be utilized for food for the worm. To make still more sure, I took a branch of the chinquapin chestnut to Dr. Kellogg, and he assured me that my idea was correct. He pronounced our chestnut (*Castenopsis chrysophylla*) to belong to the same species on which the Chinese moth, or *Bombyx pernyi*, feeds.

The importance of the wild silkworm is so great that I think the interesting subject should be brought into prominent notice. The wild silkworm is much more prolific than the domesticated. The latter has, in fact, almost lost its generative power, reproducing only once a year. The wild species is, therefore, of much greater value than the

domesticated ones. In China the wild one is raised in the open air; it feeds itself in the plantations; it reproduces several times a year; it does not cut its cocoon upon emerging, but with seeming intelligence pushes the thread aside so as to admit of its exit without cutting, and thus leaves the cocoon uninjured and in good order for reeling.

Reports contradict one another in naming the different species of silkworm, and also the different species of oak trees on which the wild silkworm feeds. Turnefort says of them: "*Quercus orientalis castaneæfolia*," though found wild on every hill in Shan-tung, is especially cultivated for the rearing of the silkworms. Miguel pronounces the (Chinese and Japanese) *Quercus serrata* to be the Georgian *Q. castaneæfolia*, which both C. Koch and Grisebach consider identical with *Q. vallanea;* though Dr. Hooker admits *Q castaneæfolia* as distinct from *Q. villánea* [Journal of the Linnæan Society]. One species of the wild silkworm feeds on the *Ailantus gladulosa*

The cocoons of that worm were introduced into France in 1856, and are now well acclimatized, and may be seen hanging in numbers on the leaves of the ailantus trees, freely planted in the Parisian boulevards, squares, and gardens, where they grow, requiring little or no care. These cocoons are now in constant demand in France, where several special manufactories work up this kind of silk, which is very strong. There are still two other wild silkworms, one Tusseh moth of Bengal, the *Antherera papia*, feeding on the castor oil plant (*Ricinus communis*); but the ailantus worm will rather die than feed on the ricinus leaf.

Dr. Williamson speaks of a third kind of wild silkworm. It is said to be of a black color and never attacked by parasites, on account of its strong aromatic smell derived from the leaves of the pepper tree, on which it lives, its scientific name being *Zanthoxylum pietenitum*.

A Jesuit missionary, F. Annilal Fantoni, in the year 1851, sent from the province of Shan-tung to the King of Italy a lot of cocoons, some skeins of silk, and some silk piece goods, all obtained from the silkworm of the oak. In 1856 some more were sent and exhibited by the same missionary in the International Exhibition of Turin; and the oak moth having been studied and found to be a new species, different from all those known at the time, it was called after the importer, *Bombyx fantony*, by which name it is known in Italy.

In 1866 Dr. McCartee, after a short residence in Chefoo, wrote a paper "On Some Chinese Silkworms." Having examined some of the moths procured from the silk growers, he recognized the insect as *Saturnia mylitta*, figured in Jardine's "Naturalist's Library," and also called *Attacus* or *Bombyx mylitta*, the "Tusseh moth" of India. All those names are now forgotten; and in the latest publication on this subject, the insect having been at last recognized as an *Attacus*, on account of the four spots or eyes in the wings, and found different from the *Attacus mylitta*, it is now always designated as *Attacus pernyi*.

In India the wild silkworm grows so rapidly that the number of cocoon crops are raised to ten a year. This rapidity of production renders this species an advantageous one for introduction and cultivation in other countries.

There is, however, a great difficulty in transporting the eggs from one country to another. This difficulty consists of the rapidity with which the eggs are hatched out, rendering transportation very risky. But, notwithstanding the risks, the introduction into Europe of so useful an insect, as soon as its productive powers were known, was not neglected. Naturalists excited the zeal of travelers in reference to the subject, and in time the desires of all were fulfilled.

The silk of the silkworm, wound off in Lyons, furnishes a very brilliant thread of a pale brown color, like ecru thread, but much stronger, and it takes all the colors by dyeing. It is desirable that all our silk growers should obtain the eggs of this silkworm in order to make a trial of it.

As for the worm originally from the North of China, it could well be developed in any country of temperate climate. Belonging to a group of insects the most gluttonous known, it could no doubt be well accommodated with our common oak.

France has imported acorns of species of two oaks from China, and is at present growing them for feeding worms. One of the Russian missionaries in China, Mr. Skatchkoff, who has for some years, like other missionaries, devoted his leisure to the culture of silkworms, has of late sent to Russia some eggs of the oak Bombyx. The Journal of the Linnæan Society says that, from the close alliance of the *Quercus mongolia* and *dentata* to the *Q. robur* of Europe, there seems no reason whatever why the Chinese oak worm could not be thoroughly domesticated in any country of temperate climate; and as experiments made on the European species of oaks have proved successful, the problem of acclimatization of the oak worm is greatly facilitated.

From what precedes we see that the Jesuit missionaries knew that the Chinese manufactured three species of silken fabrics from cocoons of silkworms, differing entirely from the *Bombyx mori*, reared in a different manner and fed upon the leaves of different kinds of trees. Duchalde says that these worms were fed by the Emperor Kang-ksi on the leaves of the Manchurian oak near Gehol.

The *Attacus pernyi*, being a bivaltine species, passes the winter in the cocoon, while the mulberry silkworm passes it in the egg. The cocoons of the oak silkworm are before and after the eclorion fit for reeling; but it is only of late that a method has been discovered in France for reeling them when opened. The method consists in forcing into each cocoon an artificial chrysalis of vulcanized India-rubber, fixed on a pin, on which the cocoon revolves.

Some years ago the raising of silkworms was fairly started in California, but it suddenly failed, and silk culture was abandoned. To start again we need animation and encouragement. But we hope our efforts will soon meet with proper sympathy, and we believe that, if we keep on trying, as they did in France, we cannot fail of achieving success.

## THE ORIGIN OF ANTHRACITE.

In a paper lately read before the National Academy of Sciences, New York, by T. Sterry Hunt, LL.D., F R.S., the author says: From my comparative studies of carbonaceous minerals I, as long ago as 1861, reached the conclusion that petroleum and anthracite form the extremes of a series, all of which may have been derived from organic matters by natural processes at ordinary temperatures.*

To this is opposed the ordinary view that anthracite, on the one hand, and petroleum on the other, result from the action of heat on matters of intermediate composition, the one being a distillate and the other a residuum. Late geological studies, however, show that such a hypothesis is untenable for petroleum, and the author, while not denying that a local coking of bituminous coals must naturally result from the proximity of igneous rocks, has long taught that it is equally so for our anthracite fields. The prevalent notion has hitherto been that the difference between these and the bituminous coals further West is in some way connected with the mechanical disturbance of the strata in the former region; but to this is opposed the fact that, while the undisturbed coals of Arkansas are anthracite, the highly disturbed coals of northeastern America, Belgium, and other regions are bituminous.

These considerations I have for many years presented to my classes in geology, and have maintained that the change which results in the conversion of organic matters into anthracite was effected before the disturbance of the strata; that the hydrogen was removed, as ordinary vegetable decay, in the forms of water and marsh-gas; and that differences in aeration during the process of change and consolidation of the carboniferous vegetation are adequate to explain the chemical differences between anthracite and bituminous coals.

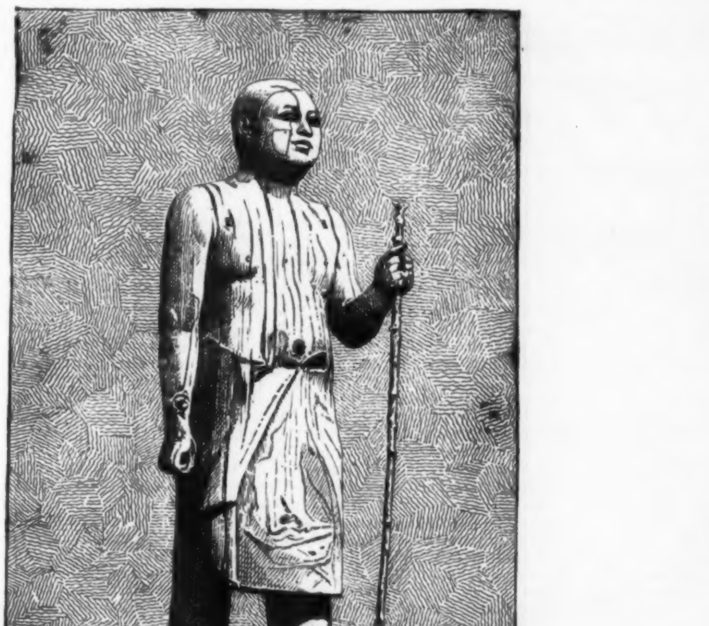
Prof. J. V. Lesley, to whom I have explained my views, has pointed out that there is an apparent connection in the great Appalachian coal basin between the more or less arenaceous and permeable nature of the inclosing sediments and the more or less complete anthracite character of the coal; while Principal Dawson informs me that he has observed similar facts in the coal-measures of northeastern America. Inquiries which promise to throw further light on this question are in progress, and the present note to the Academy is to be considered as only preliminary to a further discussion of the subject.

* *Canadian Naturalist*, July, 1861, and Report Smithsonian Institution for 1868; also Chem. and Geol. Essays.

## PREHISTORIC MEN.

THE MARQUIS DE NADAILLAC has recently published, at Paris, an interesting work on "Prehistoric Man and Prehistoric Times," containing much new information on these subjects, and many plates never before published. Among the latter is one curious one, which we reproduce, from our cotemporary *La Nature*, along with the following matter in reference to it:

It is to Cheops and to Cephren that we owe the pyramids of Gizeh, those most extraordinary monuments of human ambition. On the rocks of Sinai there may yet to-day be seen a bass-relief, which represents King Snefrou, of the third dynasty, vanquishing the nomadic tribes of Arabia Petrea; and it is to this same dynasty that are thought to belong the curious tombs of the treasurer of the king and that of the former's wife, discovered some years since at Meidoum. The stone statues of a functionary named Sepa and those of his two sons date from the second dynasty. These are preserved at the Museum of the Louvre. The paintings which cover the tomb of Ti, at Saqqarah, date from the first dynasty. Ti was an important functionary of the ancient empire, and it is due to his paintings that we are enabled to know the most intimate details of the life of the Egyptians—the cotemporaries of the first days of the monarchy. Pursuing our investigations, we arrive at the epoch of fabulous dynasties, at that of the races of gods and heroes, whose mythological legend is written on the walls of the Temple of Edfou, but which more certain hieroglyphical inscriptions call the times of the *Hor-Schesu*, *i. e.*, the servants of Horus, the national God *par excellence*. This, doubtless, is the theocratic government that Herodotus tells about, and it is to these legendary ancestors that the Egyptians attribute (probably correctly) the foundation of several towns and numerous temples. The inscriptions of Denderah mention the plan of a temple, traced on gazelle skin, in the time of *Hor-Schesu*, and which was found many ages afterward. There exists, however, in Egypt one monument at least which is anterior to the first dynasty, and which consequently dates back to that as yet unknown era; and this is the temple of Armachis, which is situated beside the great Sphinx, and which was uncovered about twenty years ago, at the expense of the Duke de Luynes. This temple, constructed of enormous blocks of granite and oriental alabaster, and supported on square monolithic pillars, is a true transition between megaliths and architecture as we now understand it, showing neither a moulding, nor an ornament, nor a hieroglyphic. In an inscription preserved at the Museum of Boulaq, King Cheops speaks of it as an edifice whose origin is lost in the mists of ages, and one which, buried beneath the sands heaped up by the desert winds, had been fortuitously discovered during his reign. The Sphinx itself, that rock so coarsely chiseled into the form of a lion, to which was added a human head constructed of layers of enormous stones, is not much less ancient. M. Lenormant believes that it antedates by several centuries those great pyramids whose guarding sentinel it seems to be, and that these temples, as we have before remarked, date from the fourth dynasty. Mariette-Bey has found sculptures which date back to 4,000, and perhaps 4,500 years before Christ. At the epoch at which has hitherto been fixed the creation of the first man, Egypt then was already in possession of an advanced civilization. All useful animals were reduced to domestication; Thinis was a flourishing city; a hierarchical society was constituted, and had a language, a hieroglyphical system of writing, a religion, and a government. It was acquainted with the sciences and arts, and produced works that were so perfect, so superior to those produced since, that we are led to consider as a long decadence all those epochs which have succeeded the one known as the *Ancient Empire*, and which embraces the first six dynasties. In order to understand what Egyptian art was in that so remote period, it is necessary to visit the museums of Boulaq and of the Louvre, of Berlin and of Turin; it is necessary to see in the French National Museum the little squatting scribe, or the statues of calcareous stone which date from the second dynasty; or, better still, there should have been seen at the Paris Exhibition, in 1867, the marvelous jewels of Queen Aah-hotep (the cotemporary and probably the mother of King Amosis), and especially that incomparable wooden statue whose renown became universal in so short a time. It is a striking portrait (see accompanying figure); the man seems to be really alive; his mouth seems to speak, and his eyes to gaze. The calm, satisfied expression shows the important functionary such as he must have appeared to his subalterns. And this art, which arrives at the first flight to heights which the ablest Greek sculptors have never exceeded, has no archaic epoch, no known infancy! We are led to ask ourselves whether the race which has peopled Egypt in that so remote past did not arrive in the Valley of the Nile with a civilization formed, with a history, with arts, with acquired knowledge, and with all that makes a great people.



ANCIENT WOODEN STATUE OF RA-EM-KE, GOVERNOR OF A PROVINCE UNDER THE SECOND EGYPTIAN DYNASTY.

## HEARING NOISES TAKING PLACE ON THE SUN.

ON visiting the Observatory of Meudon, at the invitation of M. Jansen, Mr. Graham Bell examined with much care the large photographs which are being made there for the study of the solar surface. M. Jansen having informed him that he detected movements of a prodigious rapidity in the photospheric matter, Mr. Bell had the idea of employing the photophone for the reproduction of the sounds which these movements must necessarily produce on the surface of the sun. M. Jansen approved of the idea, and requested Mr. Bell to attempt its realization at Meudon, placing all the instruments of the observatory at his disposal. The weather being very fine on the day appointed, Mr. Bell came to Meudon to attempt the experiment. A large solar image of 0·65 meter in diameter was examined with the selenium cylinder. The phenomena

were not sufficiently decided to be regarded as successful, but Mr. Bell does not despair of succeeding on further examination. M. Janssen suggested that the chance of success would be much greater if in place of directly interrogating the solar image where the variations are produced, though responding to considerable changes on the sun's surface, are not sufficiently rapid even in the most powerful instruments to cause the production of sounds in the photophone, a series of solar photographs of one and the same spot, taken at sufficient intervals to obtain well-marked variations in the condition of the spot, might be passed with a suitable rapidity before an object glass, which would give conjugated images upon the selenium apparatus. This would be a means of condensing into a time as brief as could be desired the variations which in solar images are much too slow to give rise to a sound. M. Janssen has placed himself at Mr. Bell's disposal to provide him with solar photographs suitable for carrying out this idea, and the latter has sent M. Janssen the photophonic apparatus requisite. It has appeared to M. Janssen that the idea of reproducing on earth the sounds caused by great phenomena on the surface of the sun was so important that the author's priority should be at once secured.

## CORN SUGAR.

FROM a pamphlet published in Washington, D. C., entitled "Sugar Made from Maize and Sorghum," we gather the following as the result of long-continued experiment:

According to their composition, plants containing a sweet juice may be divided generally into three classes: 1st. Those, like the sugar cane and the beet, which, when their juices are mature, contain, in association with other substances, true crystallizable sugar only. 2d. Those, like most fruits, such as the apple and the grape, which, whatever their composition otherwise, contain no true sugar, but only glucose, levulose, etc. 3d. A third class, heretofore not generally recognized as distinct, which contain, in their best condition, both true sugar and glucose, but the latter uniformly in comparative small quantity; the representatives of this class are maize and sorghum.

The last mentioned plants have a legitimate claim to be ranked with the best sugar-producing species now known, as it can be shown that the current opinion as to the uncrystallizable character of the sugar of the juices of these plants is not founded on fact. Not only are the juices of maize and sorghum grown in this country as rich, if not richer in sugars, than any other plants that can be grown in temperate latitudes, but, when in proper condition, nine-tenths of their saccharine matter is crystallizable sugar of the true cane type.

It is further stated that the cost of manufacture of these sugars here will not be more than one-half the cost of beet sugar manufacture in Europe; that the three chief items of expenditure in the beet sugar process, viz., bone-black filtration, carbonatation, and vacuum apparatus, are in this process entirely dispensed with. The first two are entirely useless, and the last is unnecessary, except, perhaps, in large operations.

The stalks or stems must be used in a green state, as it has been demonstrated that the modification of the juices of these plants setting in at the base of the stem and gradually progressing upward, begins to take place within a very few hours after they have been cut from the ground. The storing of sorghum cane for considerable periods before it is to be worked up has been a common practice heretofore; but the transformation and loss of a part, and, finally, of the whole of the crystallizable sugar, is a uniform result. Therefore it must be insisted upon, as a general rule, that both corn and cane be worked up within, at most, from twenty-four to forty-eight hours from the time of their being cut in the field. In other words, the successive operations of heading, tapping, cutting, removal from the field, extraction of the juice, defecation, evaporation, and crystallization should follow each other without any loss of time. The contact of the freshly expressed juice in the unsophisticated state, with the air, is extremely injurious if prolonged for more than an hour or two. There is no point in all these successive stages of work at which it will be safe to suspend it until the defecated sirup has reached a density of 25 or 30 degrees Baume.

The stripping off of the blades of either cane or corn should be performed immediately before the cutting and grinding of the stems. The ears of corn may be removed, however, several days previous to the time of cutting down the stalks, without damage to the juice if the blades are left on. An average of three pounds of stems of corn to the hill—a very moderate estimate—will yield 21,700 pounds to the acre of trimmed stems, giving 180 gallons of dense sirup, or 1,800 pounds of crystallized sugar, and 44 gallons of sirup of drainage (molasses).

If a growth of four pounds to the hill is secured (an average easily attained upon good soil with good culture), 2,250 pounds of sugar and 55 gallons of molasses will be obtained from 225 gallons of dense sirup.

From experiments made the past season, it is concluded that an attainable limit is 3,000 pounds of sugar and 66 gallons of molasses from an acre of land which would readily yield 100 bushels of ripened corn, and which, if planted in sugar beets, would yield about the same amount of sugar in France. The yield of sorghum in sugar will be about one-seventh greater than in corn in each of the above instances.

Not a pound of sugar is wasted from the juice obtained at the mill, and the softer substance of the stalk, either of corn or cane, yields its juice in much larger proportion than that of the southern sugar cane; and the juice itself is from 10 to 50 per cent. stronger than that of the beet ordinarily.

The chemical composition of the juice of sorghum and corn is thus given: In 100 parts of sorghum juice are 13·5 of sugar, 1·7 organic matter and salts, and 84·8 water. In corn stalk juice, 12 sugar, 1·6 organic matter and salts, and 86·4 water. French sugar beet juice, 10·65 of sugar, 4·57 organic matter and salts, and 84·77 water.

Professor Collier, Chemist of the Agricultural Department at Washington, gives this brief synopsis of the process which he has recently put in successful operation, on a small scale, for the production of sugar from the juice of the corn stalk:

First, Heat the freshly expressed juice of the cane, sorghum or maize (Indian corn), in a copper or tinned-iron vessel to a temperature, as shown by a thermometer suspended so that the mercury bulb is immersed in the juice, of 180° Fahrenheit.

Second, After the juice has been heated to 185° Fah., add and stir into it one fluid ounce of cream of lime to each gallon of juice, or from 5 to 7 pounds (pints) to each 100 gallons of juice.

Third, After adding and stirring in the cream of lime, heat the juice rapidly to the boiling point.

Fourth, When it begins to boil shut off the heat, or remove the vessel containing the juice from the fire, and so soon as the sediment begins to settle draw off with a siphon the clear liquid from the top until at least nine-tenths of the whole quantity of juice has been thus removed, leaving a thick, muddy sediment at the bottom.

Fifth, Sweep out with a broom this muddy sediment into a bag filter, and add the filtrate as it passes through the filter, to the clear liquid siphoned off.

Sixth, To the clear liquid thus obtained (under the fourth and fifth heads) which should be allowed to cool to a temperature of 150° Fah., and not lower, there is now added of "solution B" one fluid ounce to each gallon of juice, or from 5 to 7 pints to each 100 gallons of juice. At least enough of "solution B" is to be added to completely neutralize the lime in the juice; and to determine this a slip of blue litmus paper is dipped into the solution, when, if enough of "solution B" has been added, the blue color will be changed to red.

Seventh, Evaporate rapidly, skimming from time to time any scum which appears upon the surface, and adding "solution B" in small quantities, if the boiling juice will not turn the blue litmus paper red.

Eighth, When the thermometer in the boiling juice indicates a temperature of 235° Fah., the sirup should be withdrawn from the fire, and it should be kept to crystallize in a room of about 80° Fah.

To facilitate crystallization, a few grains of granulated sugar may be added to the cooling sirup when it has reached a temperature of 100° Fah.

A Mr. F. L. Stewart, a chemist of Pennsylvania, is the discoverer of "solution B" and the other chemical combinations necessary to the crystallization of the sugar. What these chemicals are and the methods in which they operate are, of course, his secrets, but the process is asserted to be so simple that any farmer can apply it.

If all that is claimed is correct, this constitutes one of the most important discoveries of the age.

## A SUCCESSFUL AFRICAN EXPEDITION.

AFRICA is overrun with explorers of all nationalities. Too often of late have we had to read of failures, of abortive attempts on the part of expensively-equipped expeditions to reach the field of their work, or of deaths by fever or assassination after the first difficulties were overcome. In spite of all, however, the unprecedented activity of recent years in this favorite field of exploration has pretty well filled up, with the leading features at least, that great blank space in the heart of the continent which in the rude maps of our schoolboy days was marked "unexplored." In the very center of that space there is still, however, a blank, giving ample scope for work for the numerous Belgian expeditions that have hitherto done so little. It was to fill up this blank to some extent that the Geographical Society, about two years ago, obtained subscriptions to send out an expedition under young Keith Johnston, who had inherited an enthusiasm for geographical work quite worthy of the name he bore. As his subordinate, and as geologist to the expedition, the society appointed another young Scotchman, Mr. Joseph Thomson, a pupil of Prof. Geikie, who recommended him to the Geographical Society. To him, we grieve to say, it has been left to tell the story of the expedition, which he did, and did well, at the opening meeting of the Geographical Society. This expedition is more remarkable than any other African expedition that we know of. The outline of its story is soon told. With 150 of the best men that could be found in and around Zanzibar, Keith Johnston left that place in May, 1879, and striking at once to the south-west, made for the north end of Lake Nyassa, which was the real starting point for fresh work. Little more than a month after the start, young Johnston, who seemed to have the nerve and stamina of an athlete, succumbed to the malarious influences of the coast region, and was buried by his companion at Behobeho, to the north of the Lufiji River. Mr. Thomson, inexperienced youth of twenty-two though he was, was equal to the emergency. With admirable tact and nerve he took his place as the sole leader of the expedition, and accomplished even more than the work which the society had chalked out for it. By an unexplored route, through barren wastes and over lofty mountains, through the sneaking Wakhutu and the warlike Mahenge, he and his followers made their way till their eyes were gladdened and their weary spirits refreshed by the sight of the waters of Nyassa. Thence, after brief rest, they resumed their march over the lofty and undulating plateau, which they found occupied the region between the north end of Nyassa and the south shores of Tanganyika. Leaving here the bulk of his followers, Mr. Thomson, with a handful of men, trudged his way over the rugged western shores of Lake Tanganyika, to visit the Lukuga and settle the question whether it was an outlet or an affluent of the lake, a question, which, one would think, could be easily solved, but on which Stanley and Cameron published diametrically opposite statements. After visiting the missionary station near the mouth of the river, and running across to Ujiji, Mr. Thomson returned to the Lukuga and traced it for some miles of its downward course. After barely escaping from the murderous Warua with their lives, the party sailed down the lake, and, rejoining their companions, made the return journey to Zanzibar along the usual caravan route with unprecedented rapidity, in about a year after the expedition set out under their late chief. Mr. Thomson declared with just pride that all this was accomplished without the shedding of a drop of blood for either offensive or defensive purposes; with one exception he brought all his men back "in the best of health and condition;" he has collected certain information about a considerable region which no white man had previously visited; he has solved one of the few remaining great problems of African geography; and he has located with certainty a great salt lake (Hikwa) whose existence previously had only been based on native rumor. Mr. Thomson is a trained geologist, and as such he has doubtless seen more than almost any previous explorer. He tells us of the metamorphic schists and gneiss which compose the mountains of the great central plateau; of the many extinct volcanic cones that lie around the north-west end of Lake Nyassa, and of the metamorphic clay slates, feldspathic rocks and volcanic porphyries and tuffs that look down on the lake from the north and north-east. His further geological insight may dispel some of the illusions that seem to be abroad as to the abounding wealth of the African interior. Much of the country between the coast and Nyassa is barren waste; and the chief characteristic of the region between Nyassa and Tanganyika he found to be "utter barrenness and the absence of anything worth trading for." Instead of the mountains of iron and the miles of surface coal, nowhere did he see a single metal in a form which a white man would for a moment look at as a profitable or workable speculation; there is very little more iron, he maintains, than is sufficient to supply the simple wants of the natives. Coal he saw none, and he does not believe that such a thing exists over the wide area embraced in his route. This may be discouraging, but it is wholesome, and may prove a check to the wild schemes sometimes broached by speculators for opening up the African interior. From the Chimboya Mountains to the south-east of Tanganyika Mr. Thomson found numerous streamlets flowing southwards, doubtless to join the Chambeze, which, after passing through many a lake and levying tribute from a region one million square miles in extent, pours its almost Amazonian volume, as the Congo, 3,000 miles below, into the bosom of the broad Atlantic. The much debated Lukuga he found, as Mr. Hore had found shortly before him, to be a broad and rapid river, flowing westwards from the Tanganyika Lake to the Lualaba, as the Congo here is called; and Lake Hikwa he saw was a fine sheet of water with no outlet, lying among the lofty mountains which stretch away east from Southern Tanganyika. What may be the extent and value of the purely geographical observations obtained by Mr. Thomson we have no means of knowing; doubtless in this respect the expedition suffered in the death of Mr. Johnston, who was a trained geographer. But in other respects, in information as to the structure of the country, the nature of its products, and the character of its varied peoples, the expedition under Mr. Thomson has been fruitful to a high degree; altogether it is one of the best pieces of original work which our not too energetic Geographical Society has ever done. Mr. Thomson's well-written and well-read paper was received with enthusiasm by an unusually distinguished audience.—*Nature.*

A CATALOGUE, containing brief notices of many important scientific papers heretofore published in the SUPPLEMENT, may be had gratis at this office.


THE

# Scientific American Supplement.

**PUBLISHED WEEKLY.**

**Terms of Subscription, $5 a Year.**

Sent by mail, postage prepaid, to subscribers in any part of the United States or Canada. Six dollars a year, sent, prepaid, to any foreign country.

All the back numbers of THE SUPPLEMENT, from the commencement, January 1, 1876, can be had. Price, 10 cents each.

All the back volumes of THE SUPPLEMENT can likewise be supplied. Two volumes are issued yearly. Price of each volume, $2.50, stitched in paper, or $3.50, bound in stiff covers.

COMBINED RATES.—One copy of SCIENTIFIC AMERICAN and one copy of SCIENTIFIC AMERICAN SUPPLEMENT, one year, postpaid, $7.00.

A liberal discount to booksellers, news agents, and canvassers.

**MUNN & CO., Publishers,**

**37 Park Row, New York, N. Y.**


TABLE OF CONTENTS.